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STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE

REPORT ON
INTERURBAN ELECTRIC RAILROAD
FOR THE
SAN FRANCISCO-OAKLAND BAY BRIDGE

NOVEMBER 1933

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California Toll Bridge Authority
Governor James Rolph, Jr., Chairman
State Capitol
Sacramento, California

Gentlemen:

Submitted herewith per your request is a report on Proposed Plan for Interurban Electric Service across the San Francisco-Oakland Bay Bridge.

In brief the report covers studies of interurban rail operation over the San Francisco-Oakland Bay Bridge, and detailed studies covering general design of facilities, estimated capital required and economic results of operation.

The plan proposed calls for the operation of high speed modern light weight electric trains between an elevated loop terminal in San Francisco and a transfer terminal in the East Bay area. It offers the most clearly cut and feasible legal plan for financing on the part of the State and provides for flexibility as to future expansion and development.

The plan proposed is estimated to cost approximately \$15,600,000 which is in excess of the tentative estimate of \$10,000,000 suggested in the Reconstruction Finance Corporation bond agreement for the bridge proper. That estimate was based on interurban negotiations, studies, and estimates which were at the time limited in extent and contemplated financing of the purchase and construction of lands and ways and structures and not the change and purchase of equipment.

It is most important at this time, due to the advancing construction stages of the bridge, that the California Toll Bridge Authority take immediate steps to arrange for the adequate financing of the interurban project subject to such future change and betterments as may be determined upon and required.

Respectfully submitted,

Earl Lee Kelly, Director
State Department of Public Works

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- B. Profile and Diagrammatic Alignment Interurban Railroad
- C. Plan & Elevation San Francisco Terminal
- D. General Layout East Bay Terminal
- E. Plan & Elevation East Bay Terminal
- F. General Plan of Articulated Unit
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- H. Typical Interurban Railroad Cross Section
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- K. San Francisco Property Required for Interurban Railroad
- L. East Bay Transfer Terminal Property and Property Damage

SECTION I. GENERAL.

A. Purpose of Report.

This report on the interurban rail structures and equipment required across the San Francisco-Oakland Bay Bridge is submitted to support the request of the California Toll Bridge Authority for the purchase by the Reconstruction Finance Corporation of \$15,000,000 of Toll Bridge Authority bonds to finance the installation of electric interurban service across the San Francisco-Oakland Bay Bridge.

B. Financing of Interurban Facilities Anticipated in Reconstruction Finance Corporation Bond Agreement for Bridge Proper.

Section 2 of Part V of the bond agreement of the California Toll Bridge Authority with the Reconstruction Finance Corporation dated December 15, 1932, anticipated the intention of the Toll Bridge Authority to request assistance from the Reconstruction Finance Corporation in financing interurban facilities.

Plans at the time were based on the assumption that the two railroad companies operating ferries across the bay would operate over the bridge with their present rail equipment, and the Toll Bridge Authority would finance and construct the San Francisco terminal, approaches, and rail facilities across the bridge. The railroads were to finance any changes in their facilities and equipment and pay rental for use of the Toll Bridge Authority's facilities. No definite commitments from the railroad companies had been or could be obtained at that time.

C. Progress Made Since Bond Agreement.

Since the bond agreement was signed, further studies and analyses of the location of a San Francisco terminal to serve

the interurban passengers have been made; various proposed plans of handling interurban service across the Bridge have been studied; negotiations with existing interurban companies, the Southern Pacific Company and Key System, Ltd., have been carried on, and conference between representatives of the California Railroad Commission, having jurisdiction over the present interurban companies and representatives of the railroads have been held.

Extensive and detailed studies have been completed by a joint committee of the engineers of the two interurban railroad companies, relative to ways and structures and equipment required, and costs thereof for through service across the Bridge. The studies were started early in 1932 and completed in May, 1933. More than twenty San Francisco terminal locations were considered. The two most feasible plans proposed in the report called for loop elevated terminals in San Francisco, connecting ways and structures, facilities on the bridge and connections with existing interurban tracks in the East Bay territory, and the changing of present equipment and provision for certain new equipment which would be required. The estimated total costs for these two plans, including cost of replacement of existing wooden equipment, are approximately \$15,000,000 and \$16,000,000 respectively.

These studies, made at the suggestion of the Department of Public Works, have been available and have been studied in detail in connection with this report.

The results of negotiations with existing rail carriers to date develop the fact that to provide adequate transportation across the Bay, the Toll Bridge Authority should finance a larger portion of the construction than had been originally contemplated and maintain a definite control over the operation.

A plan has been developed providing for high speed "Shuttle Service" across the Bridge with transfer to existing equipment in the East Bay area. This has been developed in order to make use of the latest design in moderate light weight, high speed, interurban equipment now being developed and to provide a plan that will lend itself to complete control by the Toll Bridge Authority.

D. Plan Proposed Provides Highspeed Transfer Service.

The plan that is here proposed, contemplates the construction by the Toll Bridge Authority of an elevated loop terminal in San Francisco, located south of Mission Street, between Third and Fourth Streets, with elevated tracks connecting to the Bridge; the installation of track facilities across the Bridge to a transfer terminal to be located in Emeryville in the East Bay territory, where passengers will be transferred from the Bridge train system to the existing interurban lines in the East Bay. This plan contemplates the operation of modern, high speed, electric interurban equipment across the Bridge between the two railroad terminals, a distance of approximately 7.7 miles, and the operation by present interurban companies from the East Bay terminal over their present systems, where street traffic conditions and frequent stops are controls preventing high speed, and where present equipment is adequate.

This plan will maintain as rapid transportation for passengers between San Francisco and the East Bay as the through service would with present type of equipment, and will provide more modern equipment and make possible definite ownership and control of the interurban service across the bridge by the Toll Bridge Authority. This control may be accomplished by lease of the facilities and equipment to a private company for operation, or by direct operation by the Toll Bridge Authority, if the latter method of operation is found to be necessary.

The most practical method, apparent at this time, is by means of a separate Bridge system connecting as herein proposed. This report, therefore, is made on the basis of such a plan.

In this connection attention is called to the fact that at the present time very rapid progress is being made in the development of high speed, interurban, transportation equipment. It is not possible, therefore, to set forth definite specifications as to final plans of equipment or operation which might not be modified and materially improved prior to the time necessary for placing equipment orders.

Studies are being carried on at this time by the Department of Public Works in collaboration with various equipment manufacturers regarding the design of equipment particularly adapted to operation over the Bridge, with the aim of a final design of the most modern type of equipment and facilities consistent with economic operation.

E. A. Definite Need Exists for Interurban Rail Transportation Across The Bridge.

The San Francisco Bay Bridge connects two urban districts, each having a population in excess of 600,000. The East Bay territory, including the cities of Oakland, Berkeley, Alameda, Piedmont, Emeryville, Richmond, Albany, San Leandro, and adjacent districts is in part suburban to San Francisco. Under normal business conditions between 40,000 and 50,000 people cross the Bay twice each week day, over 60% of which are regular commuters having their residence in the East Bay area. The total passengers handled by the two interurban companies on the three ferry routes now existing will approximate under normal conditions 35,000,000 per annum.

Special reference is here made to the report of The Hoover-Young San Francisco Bay Bridge Commission and to the data set forth in Section I-A thereof, dealing with interurban passenger traffic; also Section VI on traffic of the report on the Proposed San Francisco-Oakland

Bay Bridge submitted to the Toll Bridge Authority on August 22, 1932, copies of which are on file with the Reconstruction Finance Corporation.

The interurban passenger service now rendered across the San Francisco Bay generally parallels the line of the Bay bridge and is performed by Key System Ltd. and Southern Pacific Company, by a combination of interurban electric trains operating in the East Bay area, connecting with ferry boats operating between the Ferry Building in San Francisco and three ferry terminals on the East Bay side. Service is operated on 20 and 30 minute schedules during the daylight period, and 40 minute and one hour schedules at night. The average time required for passengers going from their homes to their place of work in San Francisco is shown on Table 5 facing Page 66 of the Hoover-Young Report as 58.204 minutes. A conservative estimate of the time saved by operation over the Bridge as shown therein for route No. 4, the route followed by the bridge, is 10 minutes, thus reducing the average travel time from 58 to 48 minutes. With improvement in equipment now pending, greater time saving than that estimated may be effected.

The installation of the interurban service across the Bridge in addition to saving travel time to passengers crossing the Bay, will reduce harbor congestion along the water front in San Francisco by the elimination of at least 16 to 18 ferry boat movements per hour.

The operation of interurban trains across the bridge will make possible handling by transfer the mainline passengers of three steam roads, Southern Pacific, Santa Fe, Western Pacific Co. These railroads operate passenger service from San Francisco via the Oakland Mole terminal of Southern Pacific Company at the present time.

SECTION II. DESCRIPTION OF PROJECT

A. General.

The project here proposed is shown as to general location on map marked Exhibit A, attached hereto. It consists of a loop elevated terminal located between Third and Fourth Street, and south of Minna Street in San Francisco; a viaduct with approach tracks extending southward along Hawthorne Street, thence eastward to the connection with the Bridge at Rincon Street, south of Harrison Street; a 2-track railroad on the lower level of the Bridge to the west end of the Key System fill, where the tracks will come to grade upon the present fill; a 2-track railroad along the north side of this fill, a distance of approximately 2 miles, to where the tracks will branch and extend via subways under the Southern Pacific tracks to the East Bay transfer terminal located in Emeryville, east of the Southern Pacific tracks and south of Yorba Buena Avenue; the East Bay terminal consisting of a through terminal for Bridge trains and transfer tracks and platforms for the Southern Pacific and Key System trains operating in the East Bay. The total length from center of station to center of station is 7.7 miles. Elevated structures as far as possible will be ballast deck type. Structure on the bridge will be open deck. The installation will contemplate modern interlocking and continuous train control with cab signals. Profile of the tracks is set forth in Exhibit "B".

B. San Francisco Terminal.

General Plan and Elevation of the San Francisco terminal are set forth in Exhibit "C" attached. The terminal is designed for 6 tracks and 3 platforms 720 ft. in length for platform loading

with ramps and stairs connecting with street level. Operation contemplates separate loading and unloading for elimination of congestion during peak hours. The location of the terminal provides for ready access to street cars on Howard and Mission Streets and on Fourth and Third Street, the latter connecting northward through the financial and commercial districts of San Francisco located north of Market Street. Space is allowed for street car track adjacent to the terminal to facilitate transfer to local lines. A new street connecting from the center of the station through to Mission is contemplated. Walking or travel distance for passengers to the financial and commercial center of San Francisco will be reduced on the average from 4630 feet to present ferry terminal to 3030 feet to the proposed terminal.

C. East Bay Terminal.

General layout of the East Bay transfer terminal is shown in Exhibit "D". The Plan and Elevation of the East Bay transfer terminal is shown in Exhibit "E". The plan provides for platform loading for the bridge trains and loading from first stop platforms on the interurban trains operating in the East Bay. Two tracks and 3 platforms are provided for the bridge trains with the necessary underpass for accommodating passengers between the different loading and unloading platforms. Two tracks and platforms are provided for the Key System lines and 3 for the Southern Pacific lines. Terminal Building will be of steel and reinforced concrete construction. Cost of construction and ownership of the East Bay transfer terminal representing tracks and structures for use of the bridge trains will be by the Toll Bridge Authority. The cost of ways and structures required for East Bay interurban lines will be borne by the local carriers.

D. Equipment To Be Operated Across Bridge.

Equipment to be purchased for the operation across the Bridge will be of modern, high speed type. Exact design has not been possible of determination at this time, owing, as stated heretofore, to the rapid developments now being carried on in high speed, inter-urban equipment design. Preliminary designs have been prepared on the basis of 2 body articulated units, the unit being 120 ft in length and having seating capacity of 156 passengers, units to be so constructed as to operate in trains of 6 units or less each. See Exhibit "F". These units are planned to be constructed for free running speeds of from 55 to 60 miles per hour on the level and of modern design with particular regard to reduced weight and to safety and quietness of operation. Other designs being considered contemplate moderate light weight cars approximately 72 ft in length with seating capacity of 100 to 110 passengers.

The amount of equipment required for present service represents 65 articulated units of 156 seating capacity or 90 cars of 110 seating capacity. The number of units required has been determined on the basis of the present peak travel with seats provided for all passengers. See Table No. 1.

In this connection it is to be pointed out that present service between San Francisco and East Bay and also service on the Peninsula lines south of San Francisco is on the basis of adequate seating capacity to accommodate all passengers even under peak load conditions. Equipment to handle the estimated traffic with completion of the bridge is estimated at 70 articulated units or 100 cars as a minimum.

The equipment contemplated to be purchased will be designed on the basis as heretofore stated of a maximum of 60 miles per hour free running speed on the level, with motor and brake equipment for

TABLE NO. 1

SAN FRANCISCO-OAKLAND BAY BRIDGE
INTERURBAN FACILITIES

Sheet 1 of 3

SHUTTLE SERVICE

COMPUTATION OF EQUIPMENT REQUIRED

Year	Total Interurban Passengers For Year	Estimated Passengers 5 p.m. to 5:30 p.m. East Bound Pk.	Estimated Units Required to handle Passengers without Standees. Includes 5 spare units.			
			2 Body Articulated Units 120 ft. length 156 Seats		Interurban Cars 72' long 110 seats	
			No.	Cost at \$65,000 per unit	No.	Cost at \$45,000 per unit
1925	39,847,097	15,800	105	\$6,825,000	148	\$6,660,000
1928	35,442,864	14,550	99	6,445,000	137	6,165,000
1929	34,360,000	12,500	85	5,525,000	119	5,355,000
1933	27,000,000	9,350	65	4,225,000	90	4,050,000

Note: 30 minute peak used as time for round trip
of equipment segregated as follows:

East Bound	12 minutes
East Bay terminal	1 minute
West Bound	12 minutes
San Francisco terminal	5 minutes
	30 minutes

high acceleration and deceleration. The operating time between terminals with such equipment is estimated at an average of 12 minutes for the 7.7 miles average distance between terminals. On this basis the time of travel between the two sides of the Bay will be reduced below the present by approximately 10 minutes.

SECTION III - BENEFITS

Benefits to be obtained by the installation of service provided for by the project here proposed will be:

a. A saving in time of travel by passengers between origin and destination of an average of 10 minutes per trip for approximately 35,000,000 passenger trips or 5,830,000 passenger hours per year.

b. Reduction in congestion of boat operation along the San Francisco water front by the elimination of 16 to 18 ferry boat movements per hour now occurring in the handling of interurban service.

c. Elimination of the hazard of operating the ferry boats from east to west past the Bridge piers and across the line of movement of ocean going ships particularly in foggy weather. There are on the average 28 days per year when dense fogs occur which seriously delay ferry operations and increase the hazard of operation. These fogs are particularly serious during the morning and evening travel peaks and often delay operations materially.

SECTION I V. ESTIMATED COST OF PROJECT

A. Construction Cost and Property.

For convenience in analyzing construction cost the work contemplated has been divided into sections which would probably be let under contracts corresponding to the sections.

The Joint Engineering Committee of the Carriers made detailed estimates of those sections involving the San Francisco Terminal, viaducts and facilities across the bridge. These have been studied and in general have been used as a basis of the estimates for Contracts R. R. 1 to 4 inclusive, modified for contemplated alterations in plans.

Contract R. R. 5 involving, as it does, standard track construction has not been itemized in as much detail but has been estimated on a track foot basis.

Contract R. R. 6 involving the East Bay Transfer Terminal covers that part representing ways, structures and land to be owned by the Toll Bridge Authority; the balance will be constructed and owned by the Southern Pacific and Key System Ltd. for their portions of track and terminal facilities. Estimated costs of facilities for these carriers are shown to indicate total cost of the combined terminal.

To each section or proposed contract has been added 15% general expense and contingencies in order that the cost for that portion of the work be shown in total. This is felt to be preferable to segregating administration, engineering, contingencies and incidental expenses separately covering all contracts.

Property acquisition and damage is being submitted under a separate appraisal appendix, segregated totals only being tabulated

in the main body of this report under the proper contract so as to show the total cost involved in each section covered by the respective contract. A summary of these costs is included giving totals only of the detailed estimates here shown.

B. Purchase of Equipment.

Equipment cost Contract R. R. 7, has been estimated on the basis of \$65,000, per two body articulated unit 120' long of 156 seating capacity or \$45,000 per car for 72' 6" cars of 110 seating capacity. These costs are in turn based on consideration of costs of recently purchased equipment adjusted to reflect reduced weight and improved braking and electric equipment. The total cost of this Contract covering either 70 articulated units or 100 cars is \$4,500,000.

The following is a summary of the estimated total cost of the Toll Bridge Authority portion of the project including equipment to be purchased.

TABLE NO. 2

SAN FRANCISCO-OAKLAND BAY BRIDGE

INTERURBAN RAILROAD FACILITIES AND EQUIPMENT

Sheet 1 of 1

SUMMARY OF ESTIMATED COST

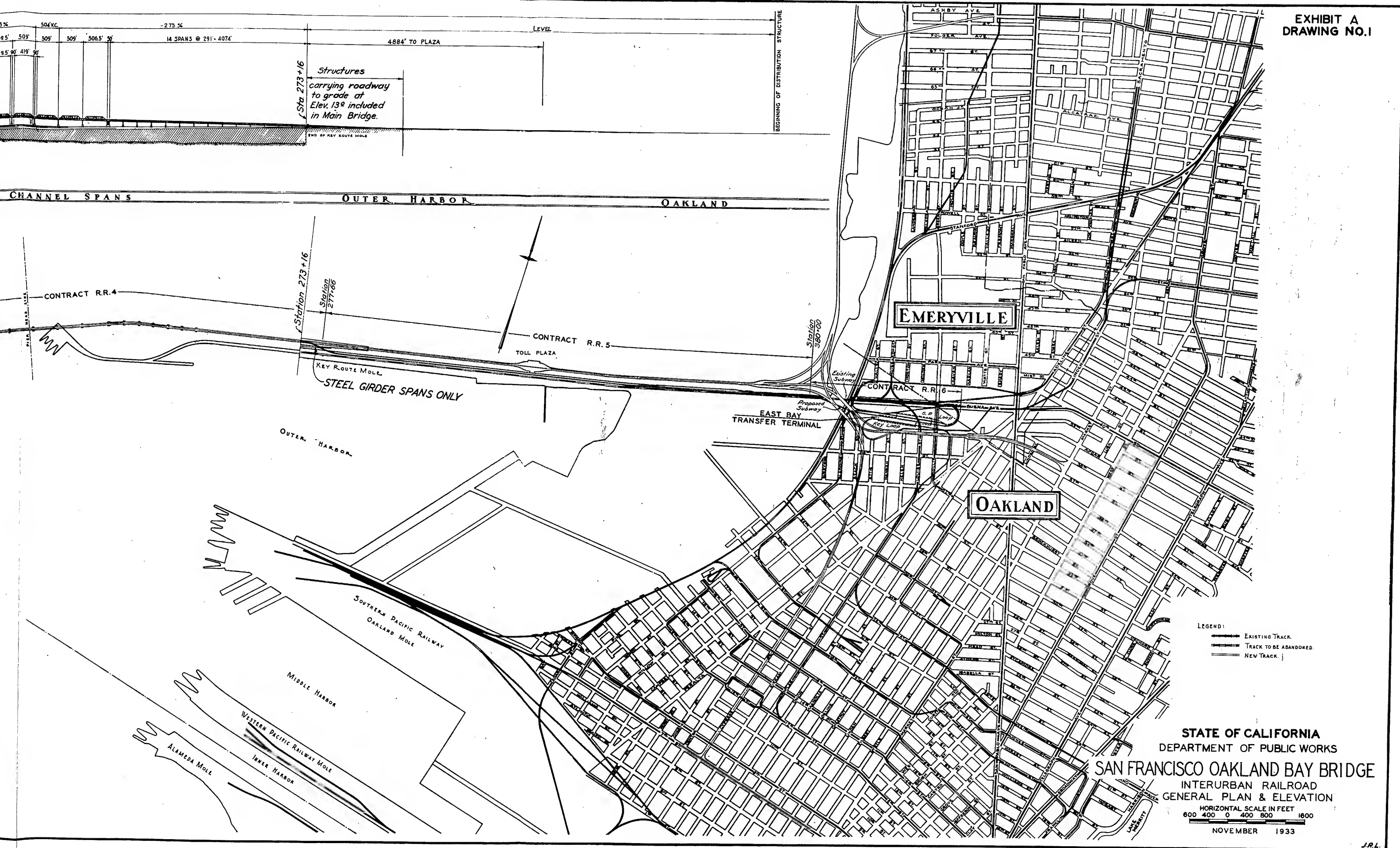
Contract R. R. 1	Viaduct	\$ 2,479,678
Contract R. R. 2	Terminal	3,501,337
Contract R. R. 3	Balloon Track	1,511,277
Contract R. R. 4	Bridge Tracks	1,135,179
Contract R. R. 5	East Bay Mole	400,067
Contract R. R. 6	East Bay Terminal	1,252,898
	Subtotal	<u>10,280,436</u>
Contract R. R. 7	Equipment	4,500,000
	Total	14,780,436
	Interest during Construction	<u>781,185</u>
	TOTAL	\$15,561,621

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STATE OF CALIFORNIA
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SAN FRANCISCO-OAKLAND BAY BRIDGE

REPORT ON
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FOR THE
SAN FRANCISCO-OAKLAND BAY BRIDGE

NOVEMBER 1933



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
PROFILE AND DIAGRAMATIC ALIGNMENT
INTERURBAN RAILROAD BETWEEN
SAN FRANCISCO AND OAKLAND

NOVEMBER ,1933.

EXHIBIT B

N 78° 46' 48.84" E

KEY MOLE FILL SECTION

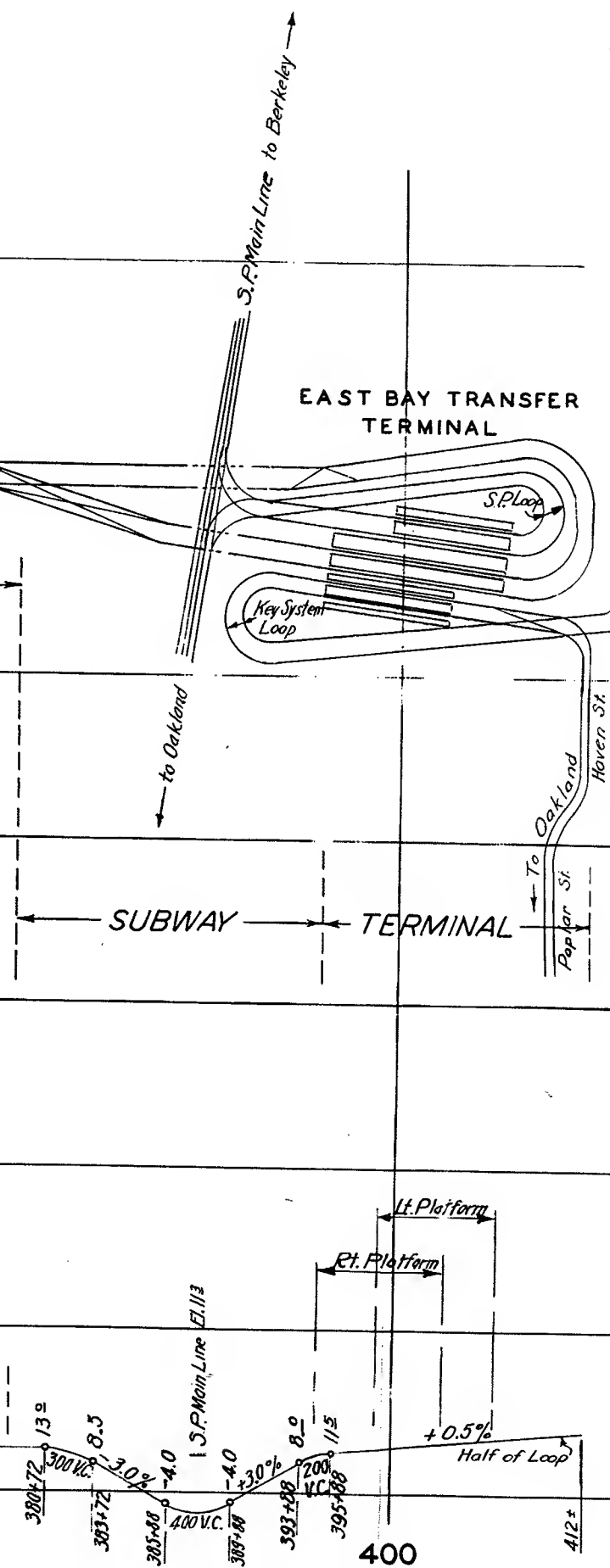
EAST BAY TRANSFER
TERMINAL

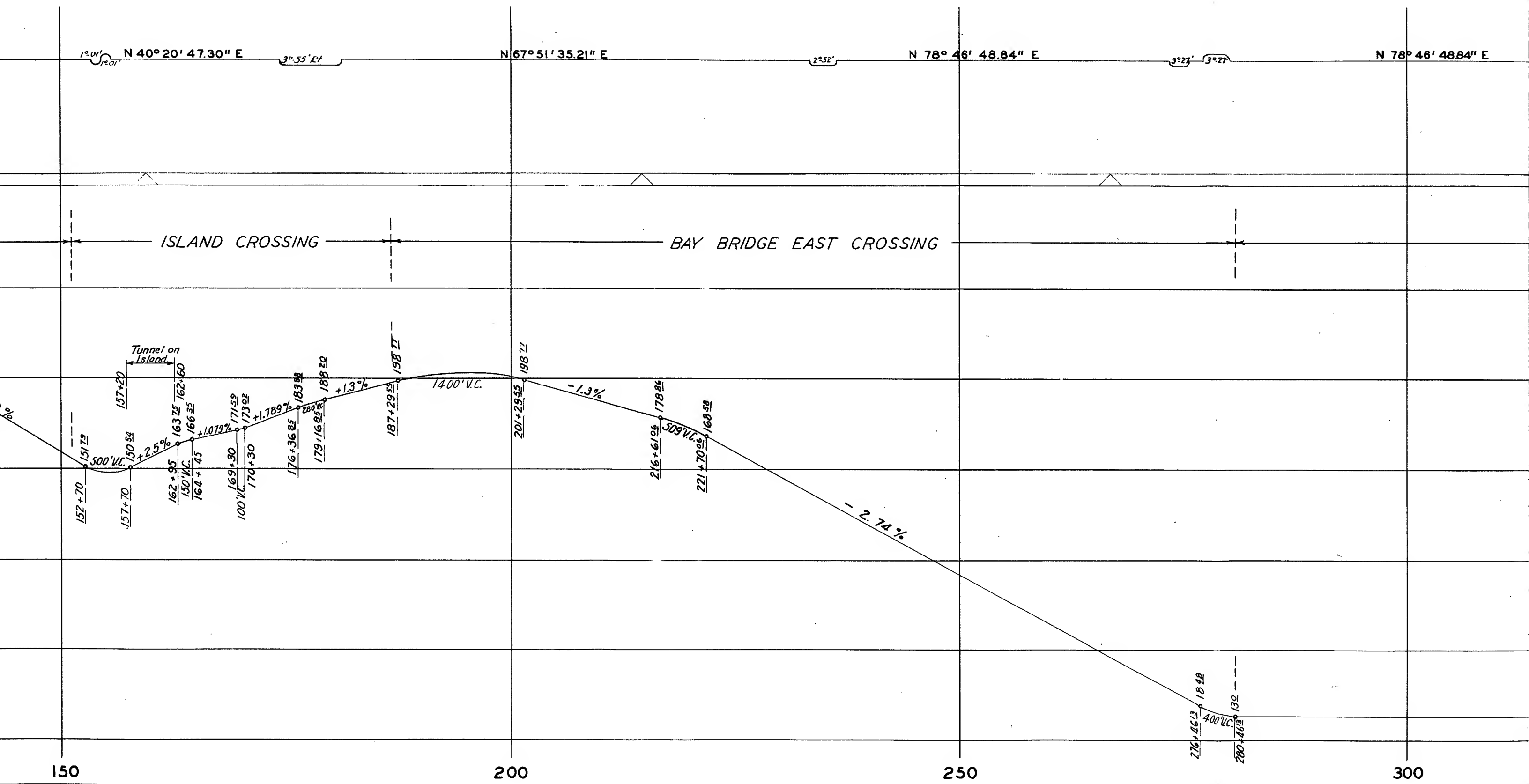
Key System

SUBWAY

TERMINAL

Level





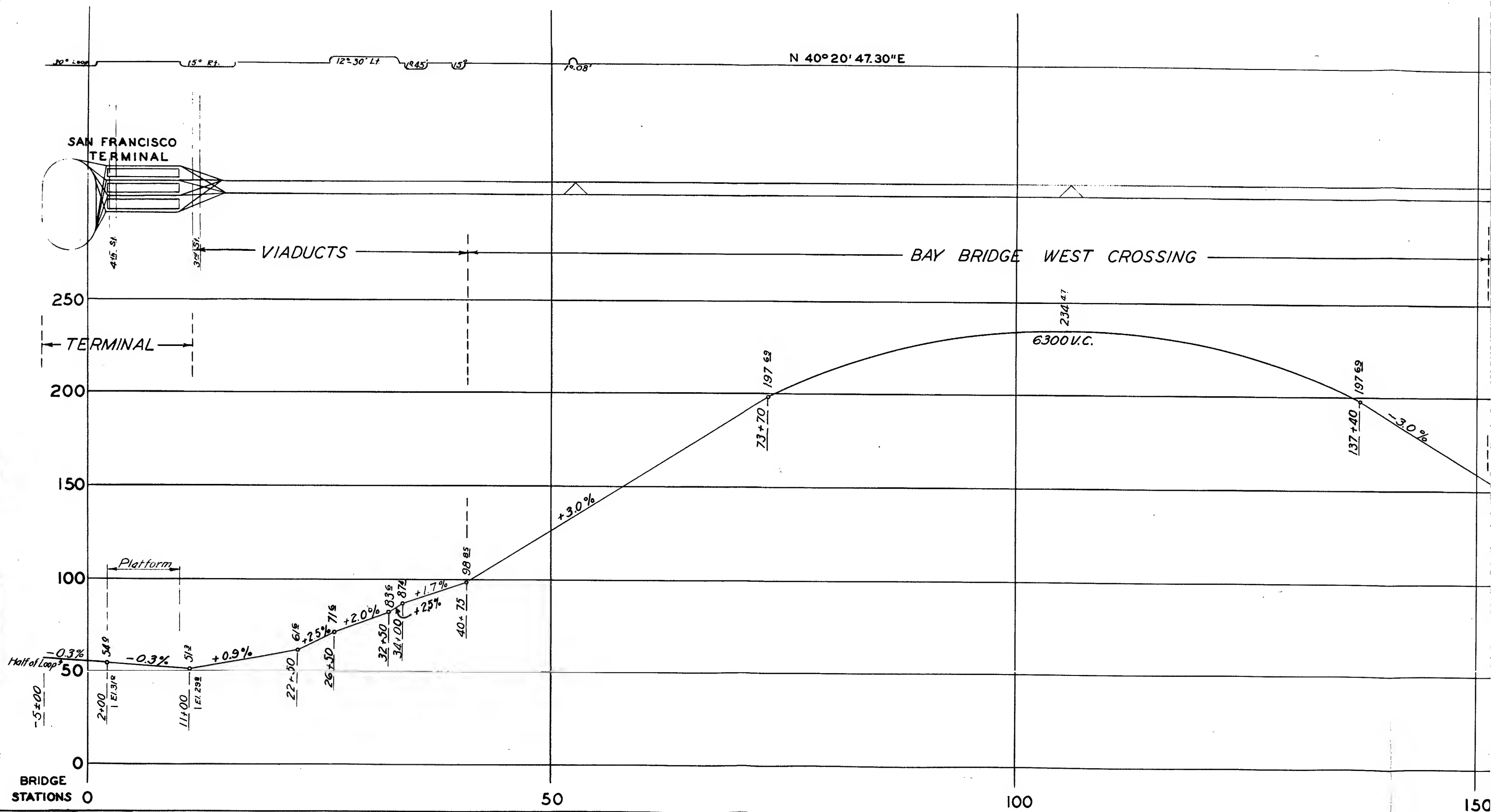
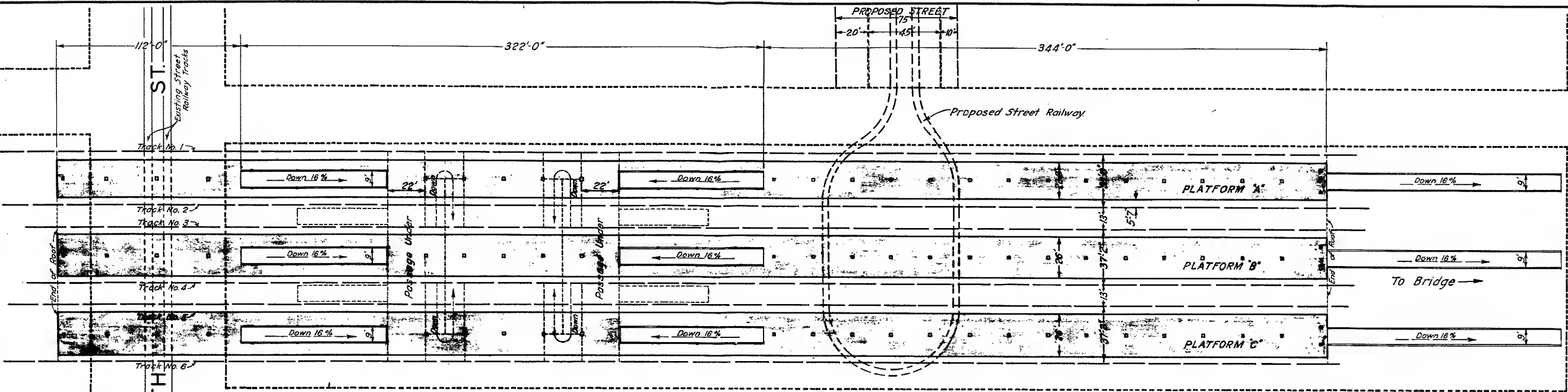


EXHIBIT C

ST.

SHERWOOD PL.

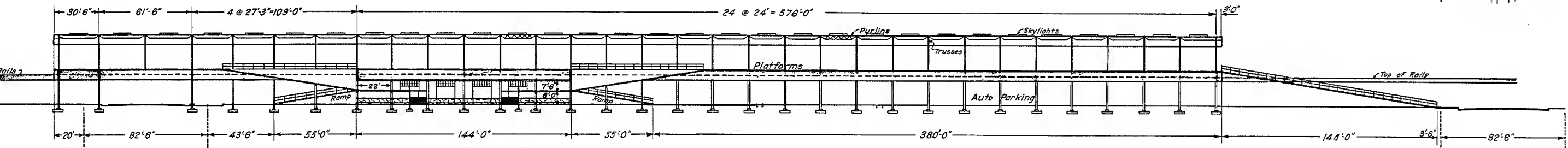


NATOMA

ST.

—PLATFORM LEVEL PLAN—

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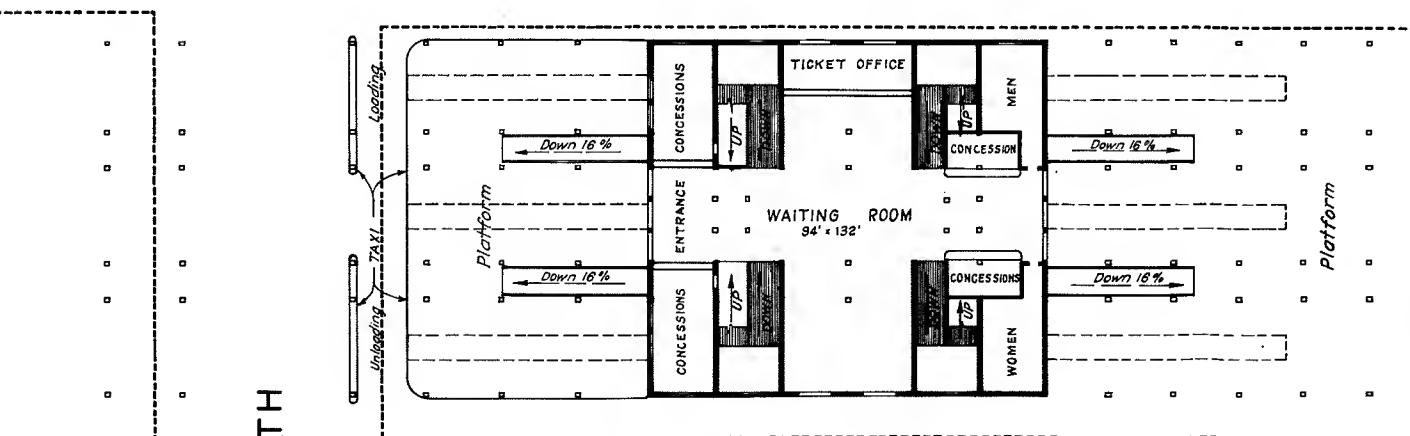


ST.

—LONGITUDINAL SECTION—

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ST.

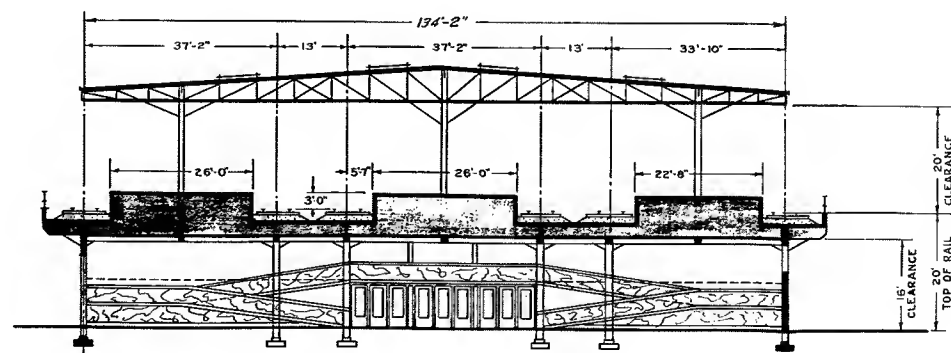


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ST.

—STREET LEVEL PLAN—

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—SECTION A-A—

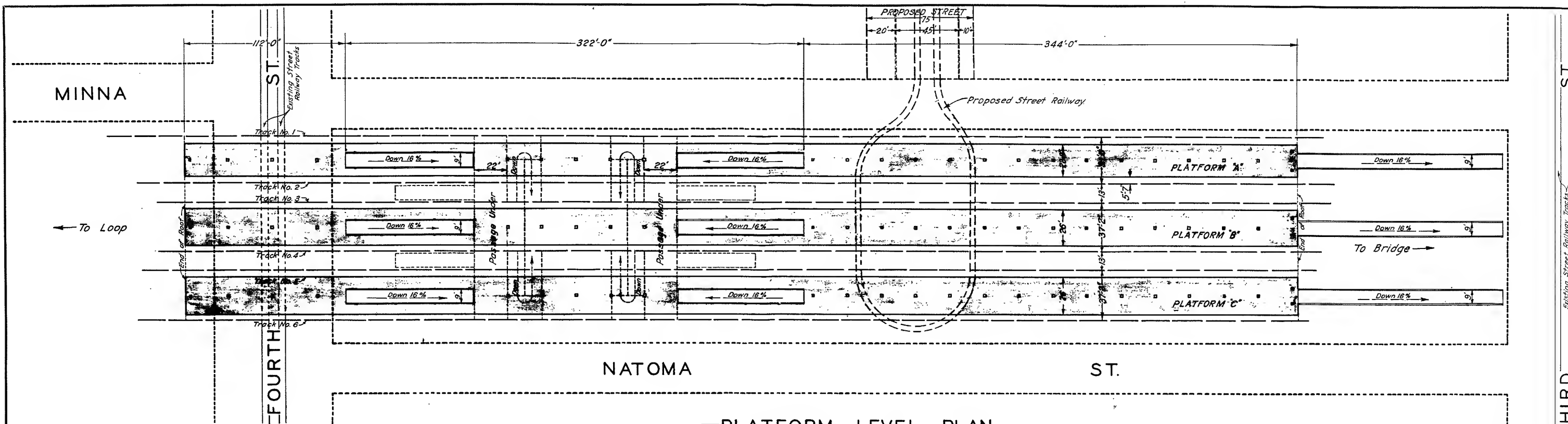
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STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
INTERURBAN RAILROAD
SAN FRANCISCO LOOP
TERMINAL

CONTRACT NO.

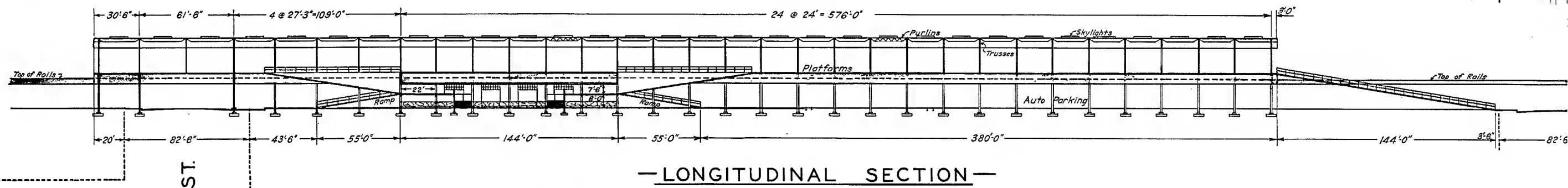
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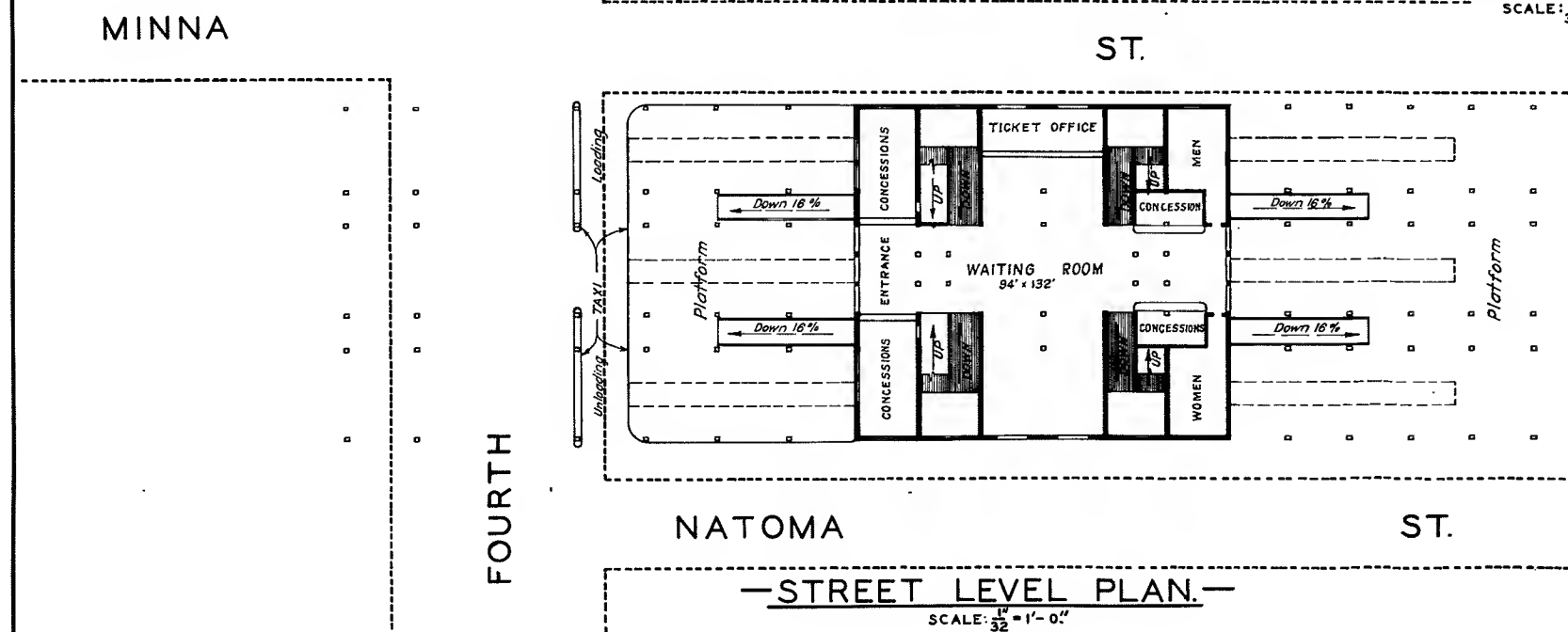
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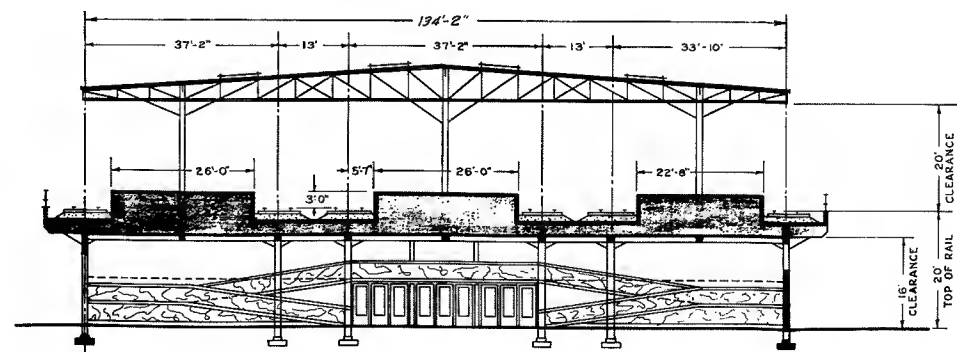
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—STREET LEVEL PLAN—

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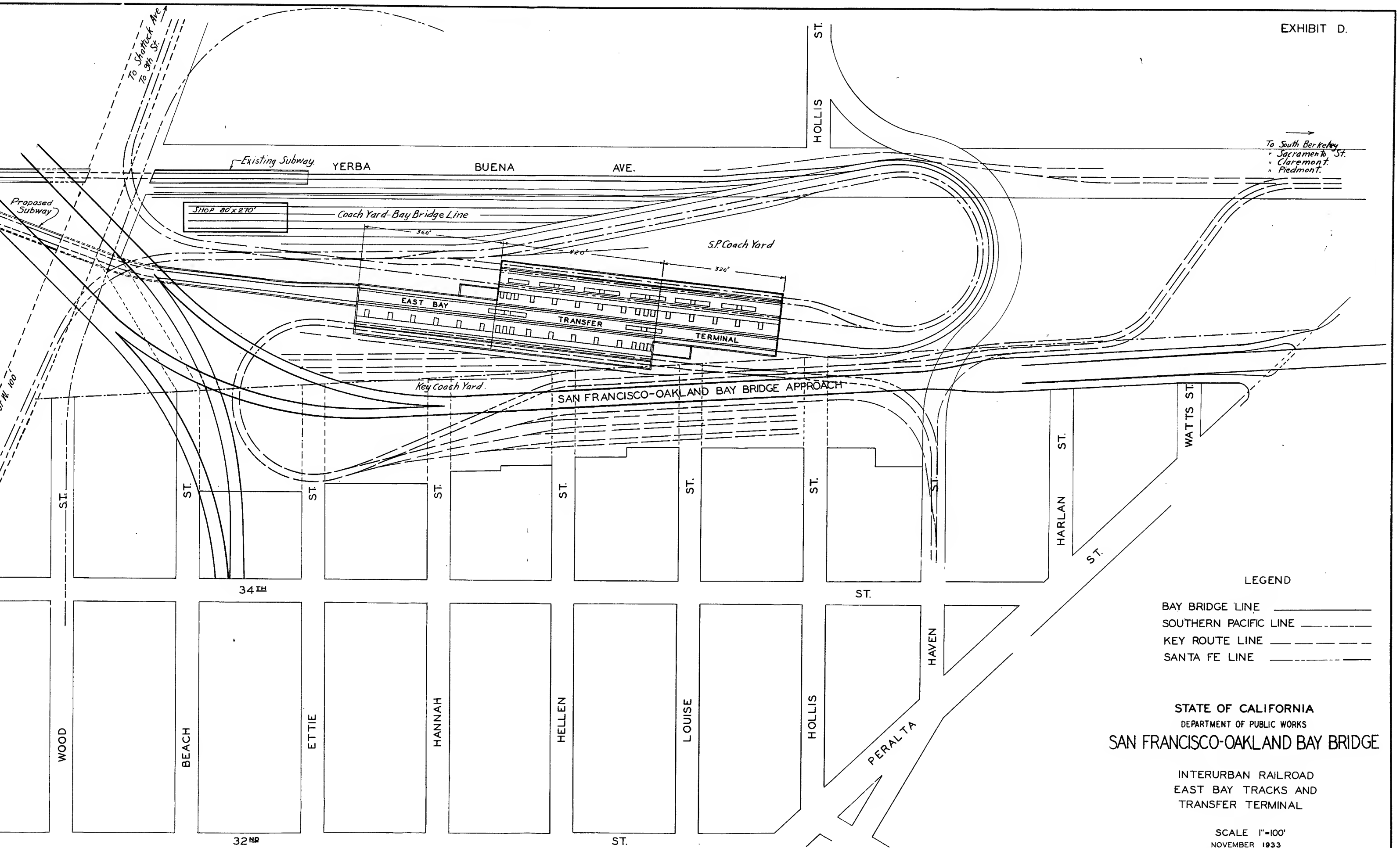


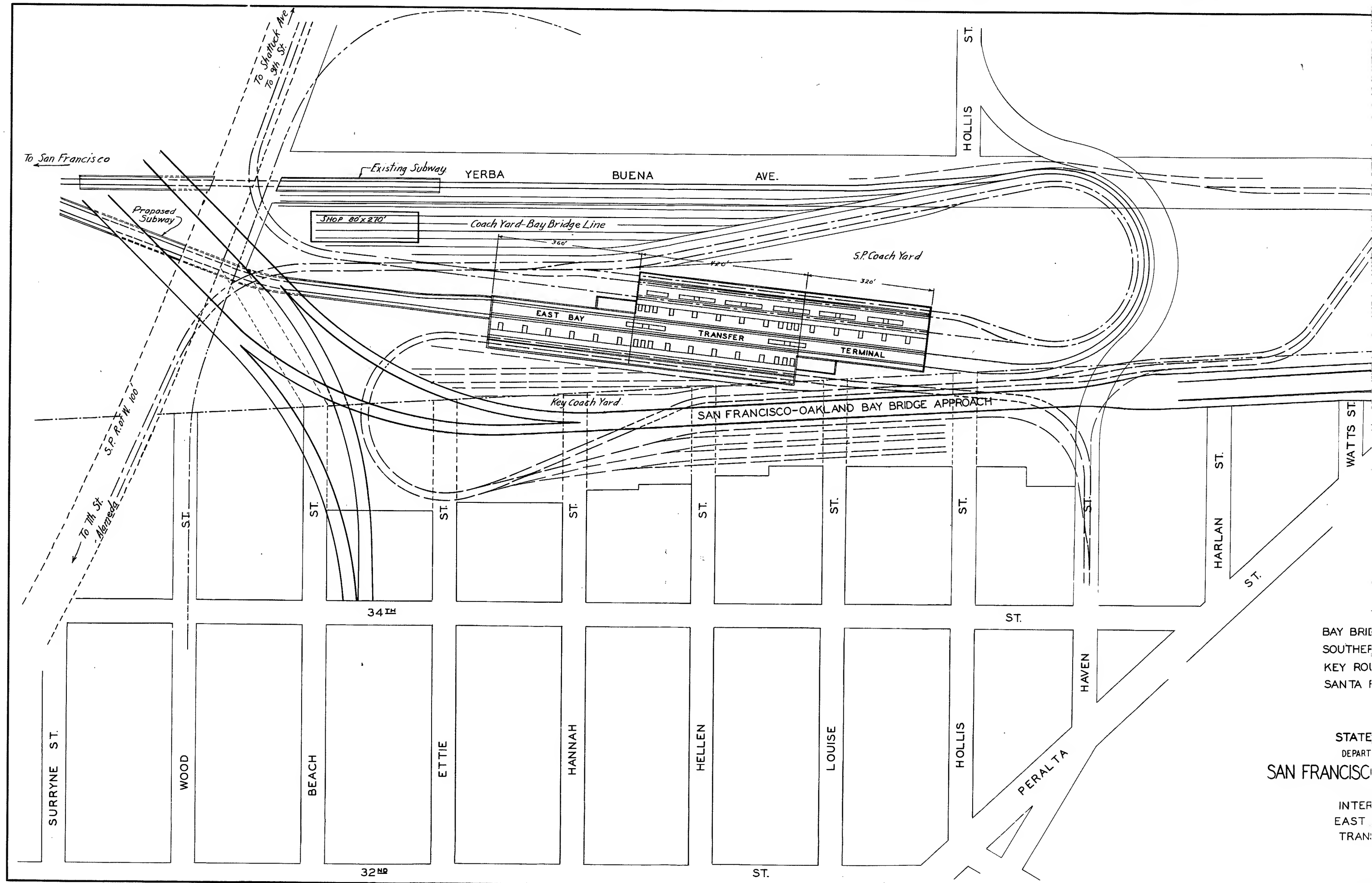
—SECTION A-A—

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STATE
DEPARTMENT
SAN FRANCISCO
INTERURBAN
SAN FRANCISCO

CONTRACT NO.

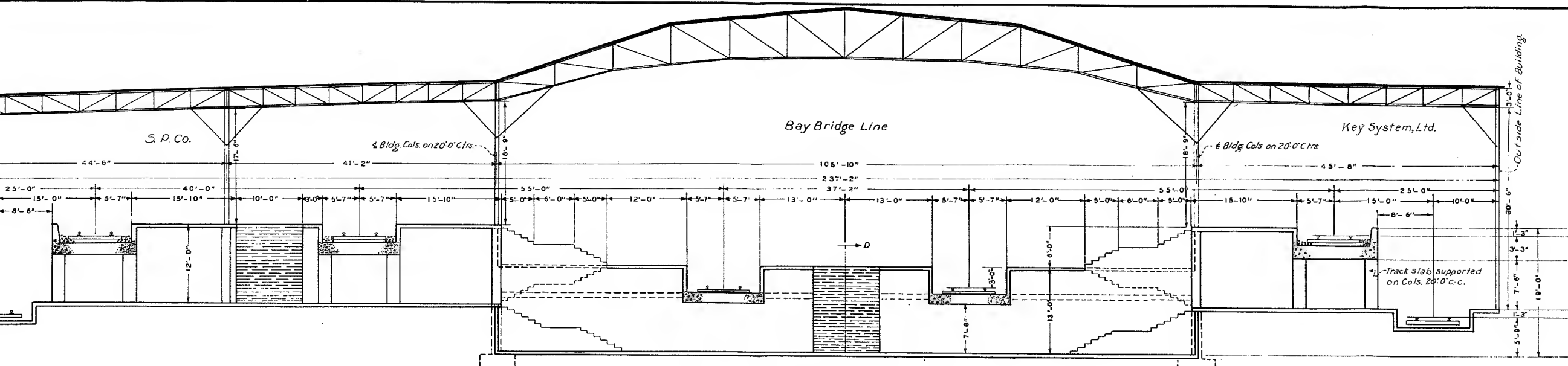




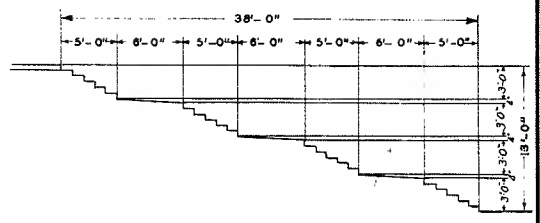
BAY BRIDGE
SOUTHERN
KEY ROUTE
SANTA FE

STATE
DEPARTMENT
SAN FRANCISCO

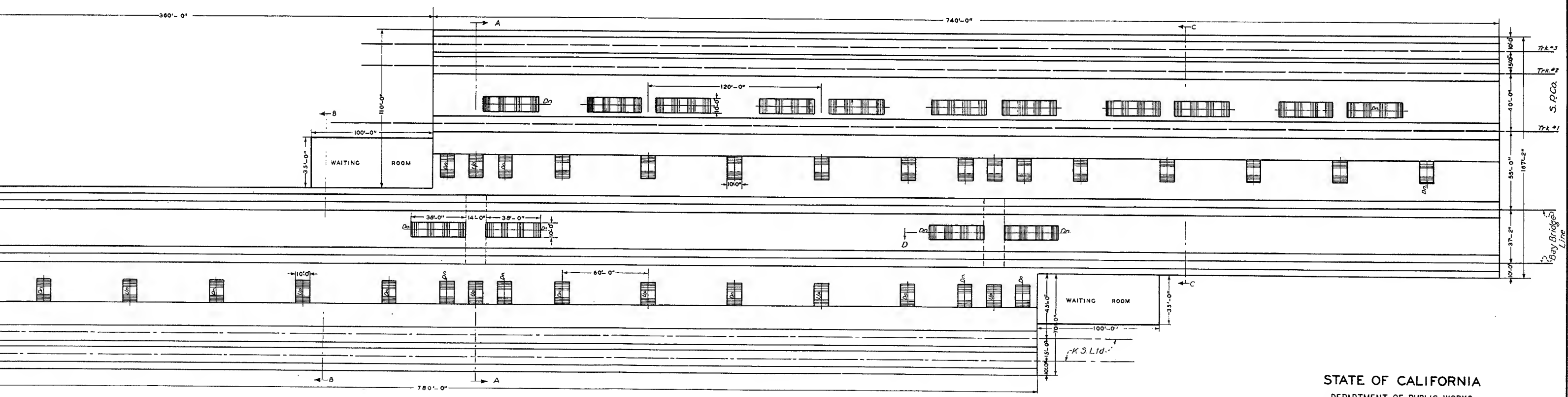
INTER
EAST
TRANS



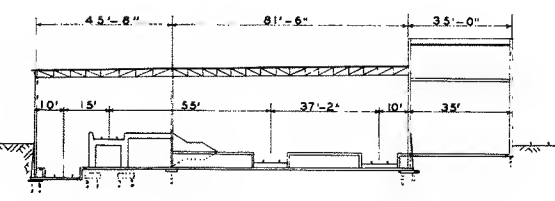
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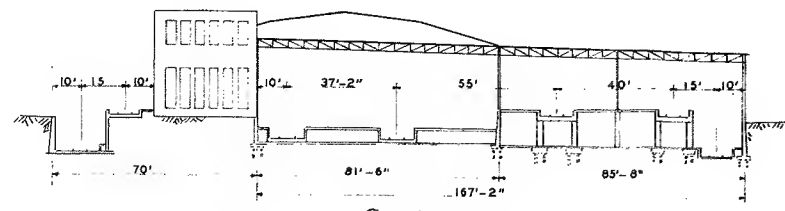
Stair Detail 'D'
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Plan
Scale 1" = 30'-0"



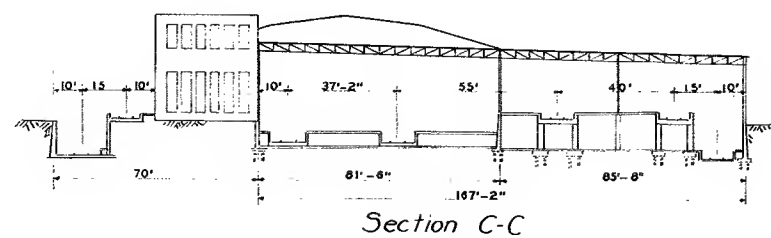
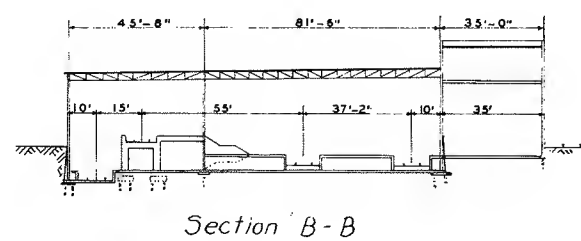
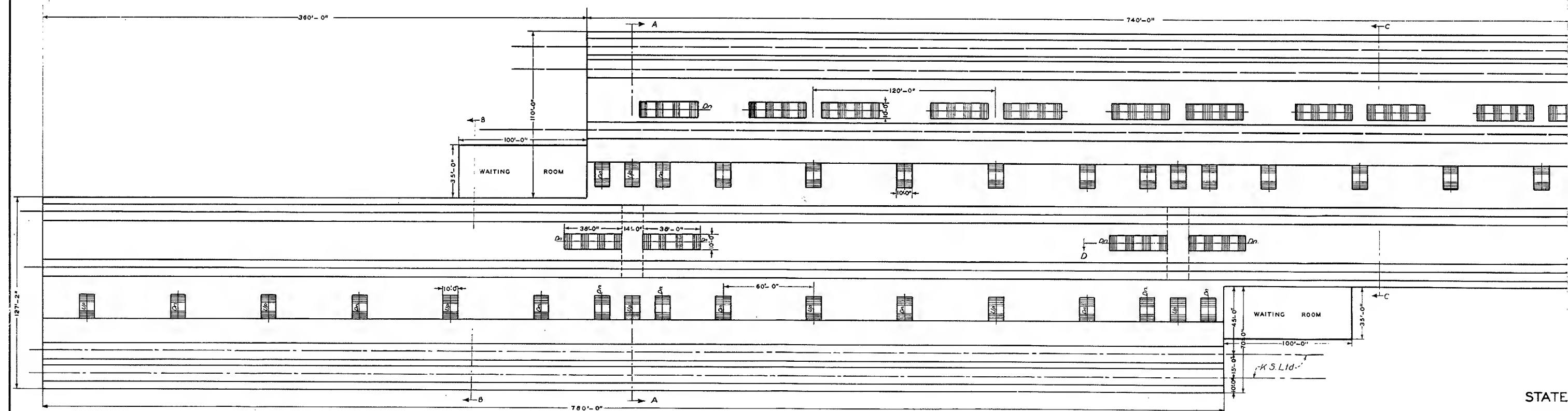
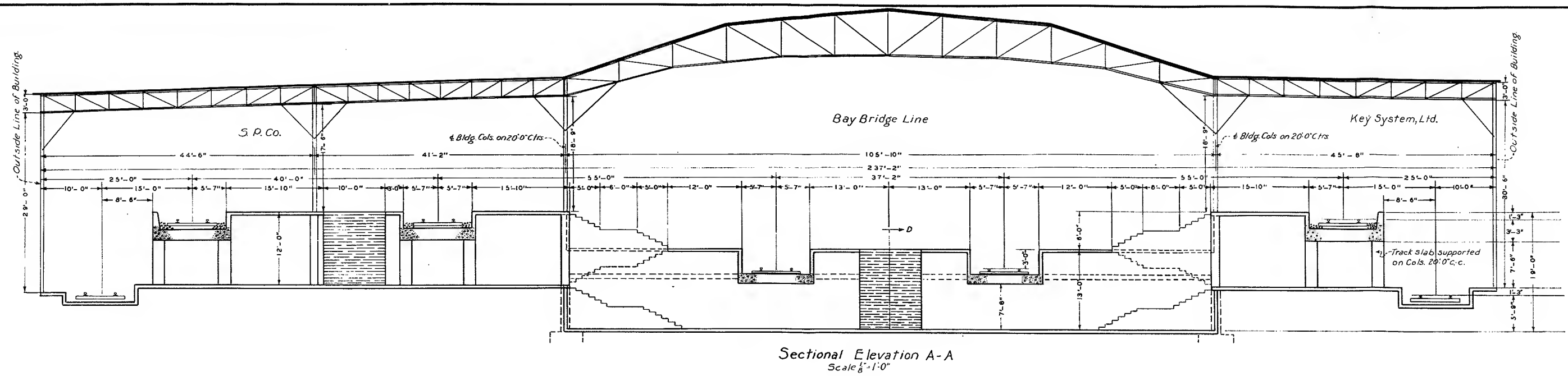
Section B-B



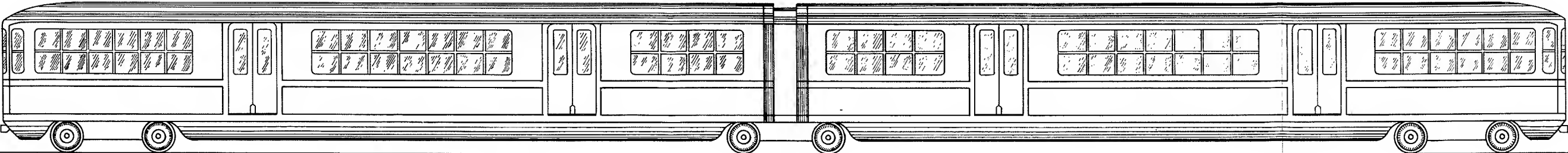
Section C-C

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
INTERURBAN RAILWAY
PLAN AND SECTION OF
EAST BAY TRANSFER TERMINAL

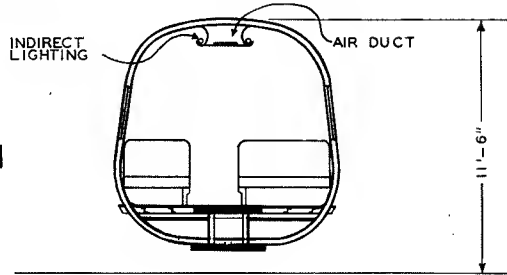
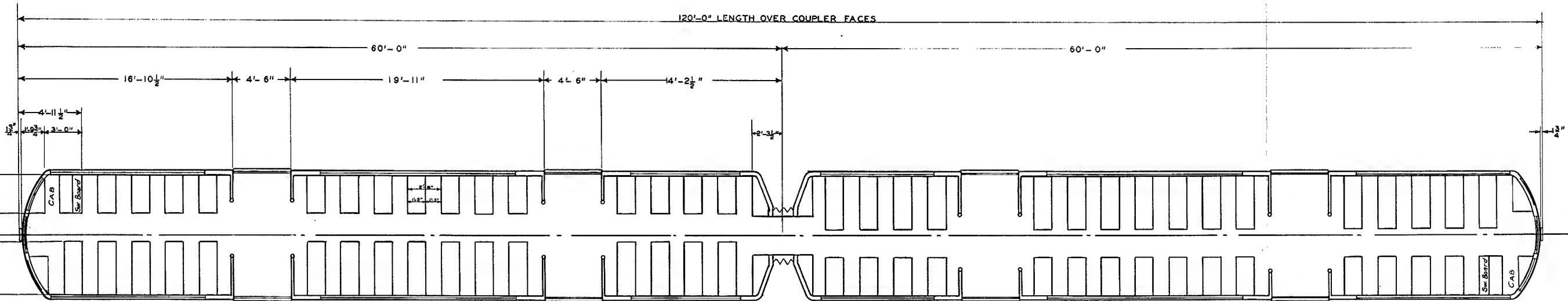
CONTRACT NO. DRAWING NO.
NOVEMBER 1933



STATE
DEPARTMENT
SAN FRANCISCO
INTERURBAN
PLANNING
EAST BAY
CONTRACT NO.



ELEVATION

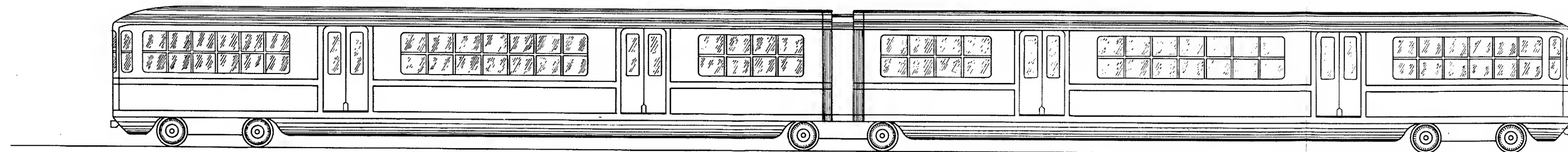


PLAN
TWO CAR ARTICULATED UNIT
CAPACITY

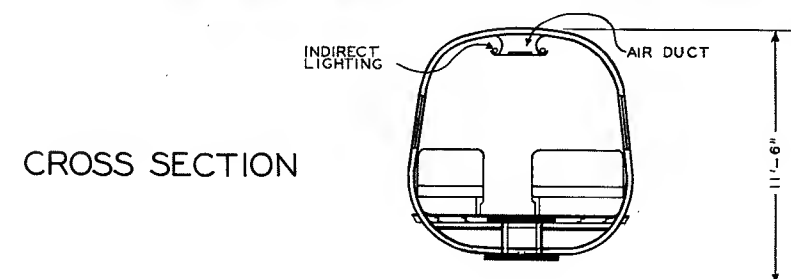
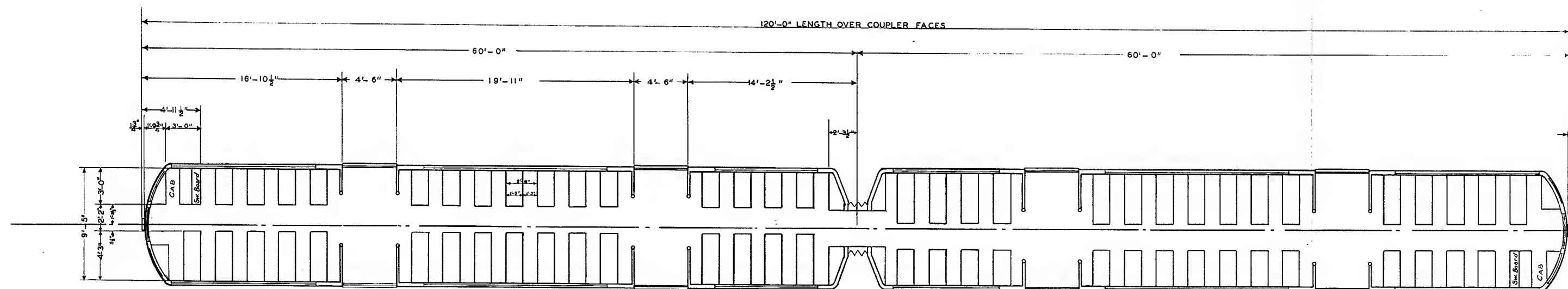
SEATS	WIDTH	PASSENGERS		
		SEAT	CAR	UNIT
15	36"	2	30	60
16	51"	3	48	96
TOTAL			78	156

AISSLE AREA=195 SQ.FT.PER CAR
SCALE 1/4" = 1 FOOT

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
GENERAL TYPE OF EQUIPMENT
PROPOSED FOR INTERURBAN RAILROAD



ELEVATION



CROSS SECTION

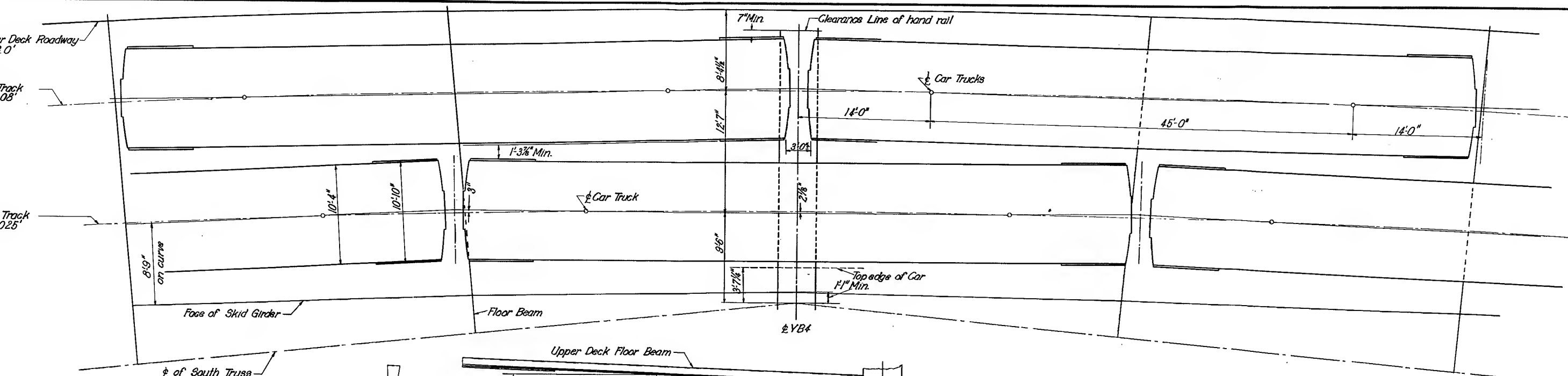
PLAN
TWO CAR ARTICULATED UNIT
CAPACITY

SEATS	WIDTH	SEAT	PASSENGERS	UNIT
15	36"	2	30	60
16	51"	3	48	96
TOTAL			78	156
AISLE AREA=195 SQ. FT. PER CAR				

SCALE $\frac{1}{4}" = 1$ FOOT

STA
DEP
SAN FRANCISCO
GENERA
PROPOSED F

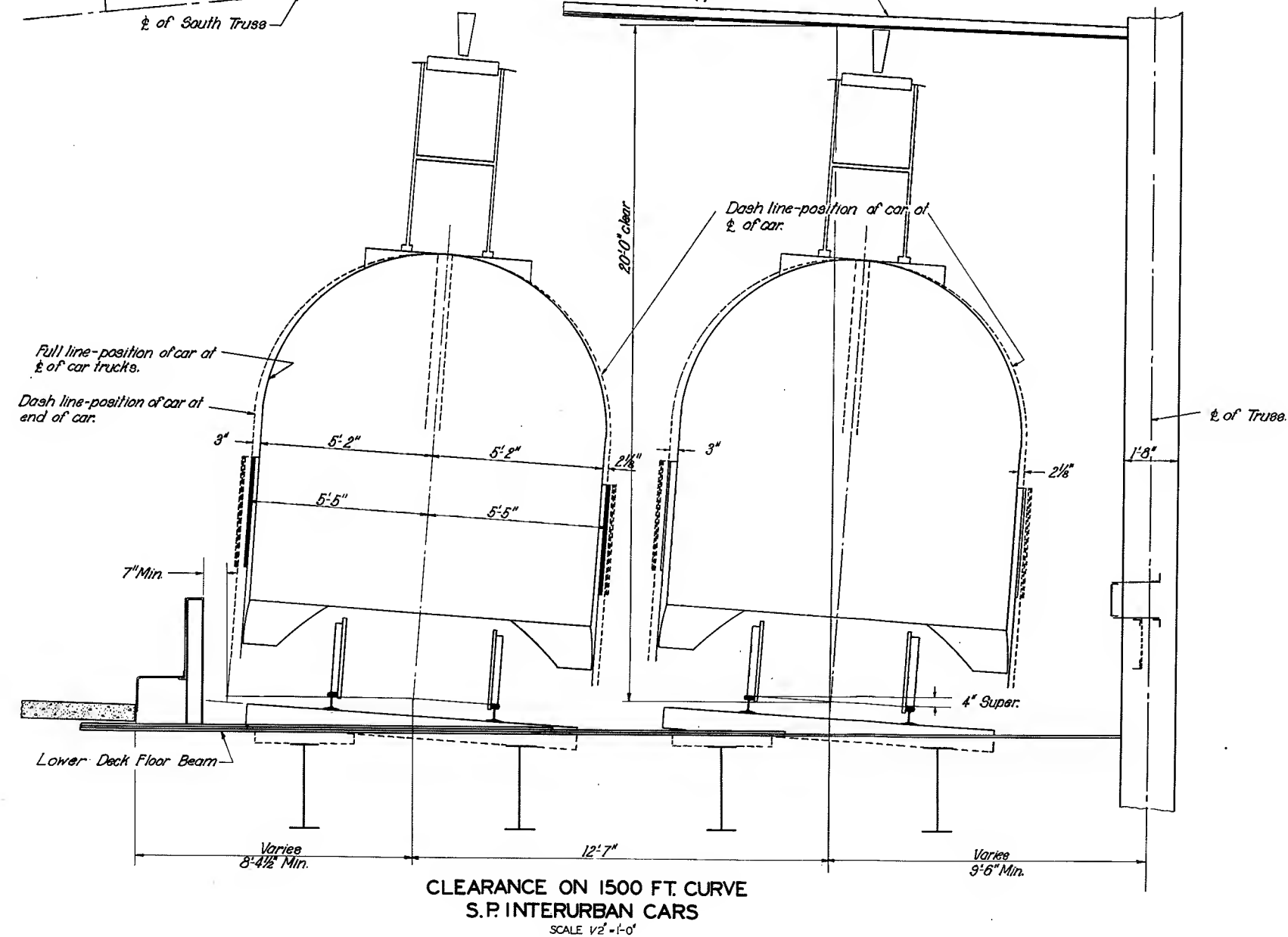
CONTRACT



PLAN AT YB4

SCALE 1"=5'-0"

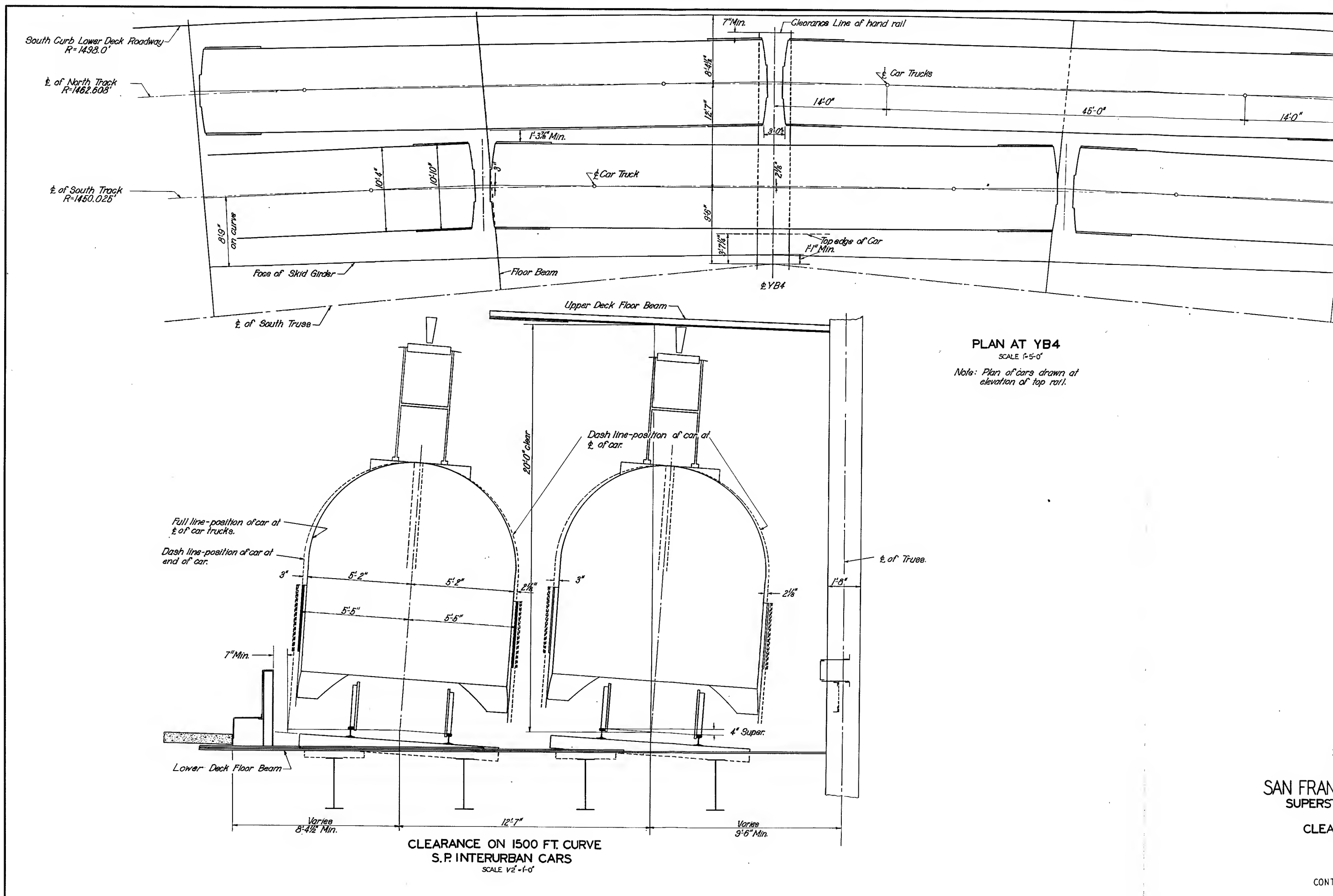
Note: Plan of cars drawn at elevation of top rail.



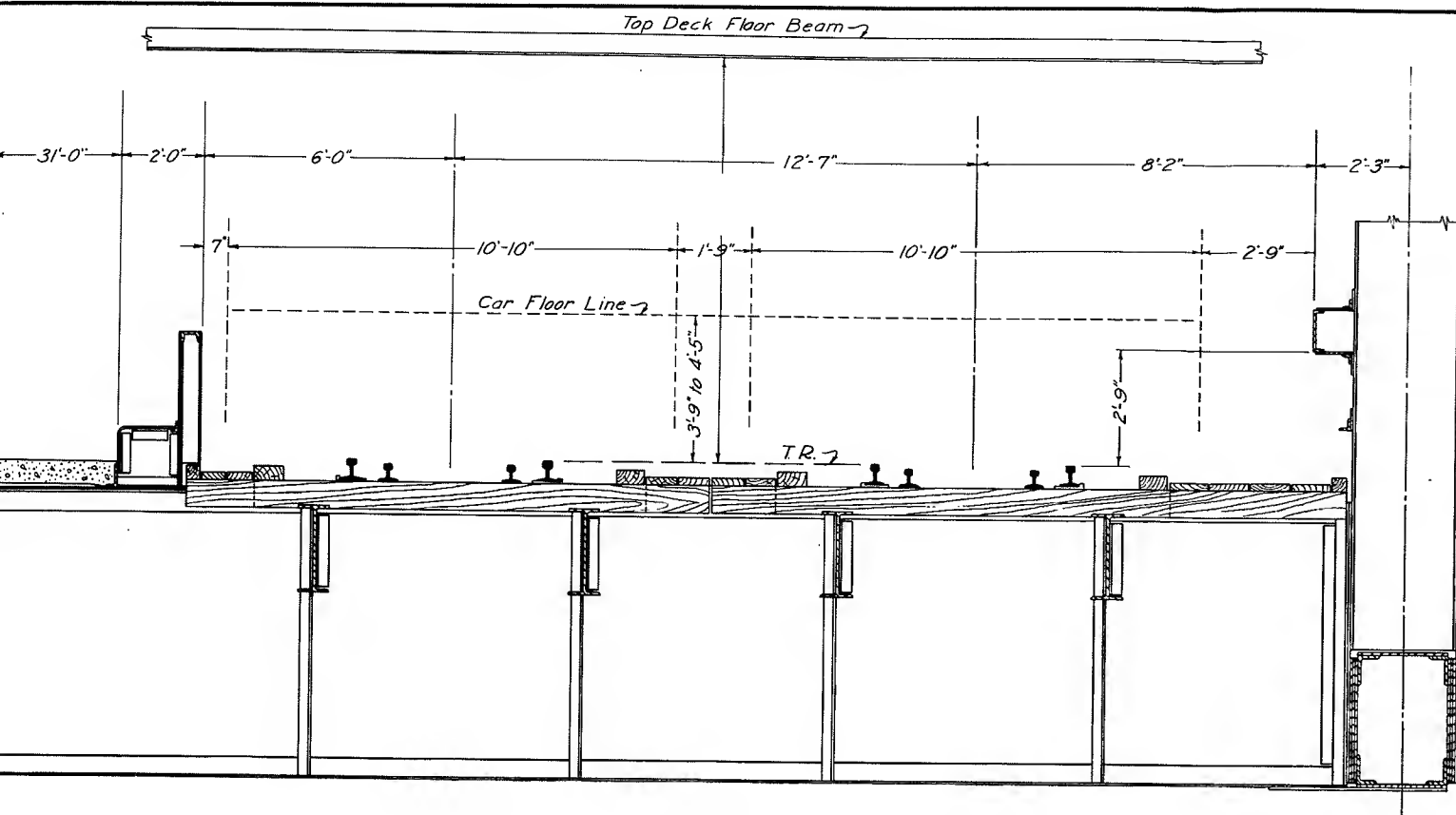
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE
SUPERSTRUCTURE - EAST BAY CROSSING
288 FT. SPANS
CLEARANCES ON 1500 FT. CURVE

SCALE-AS SHOWN

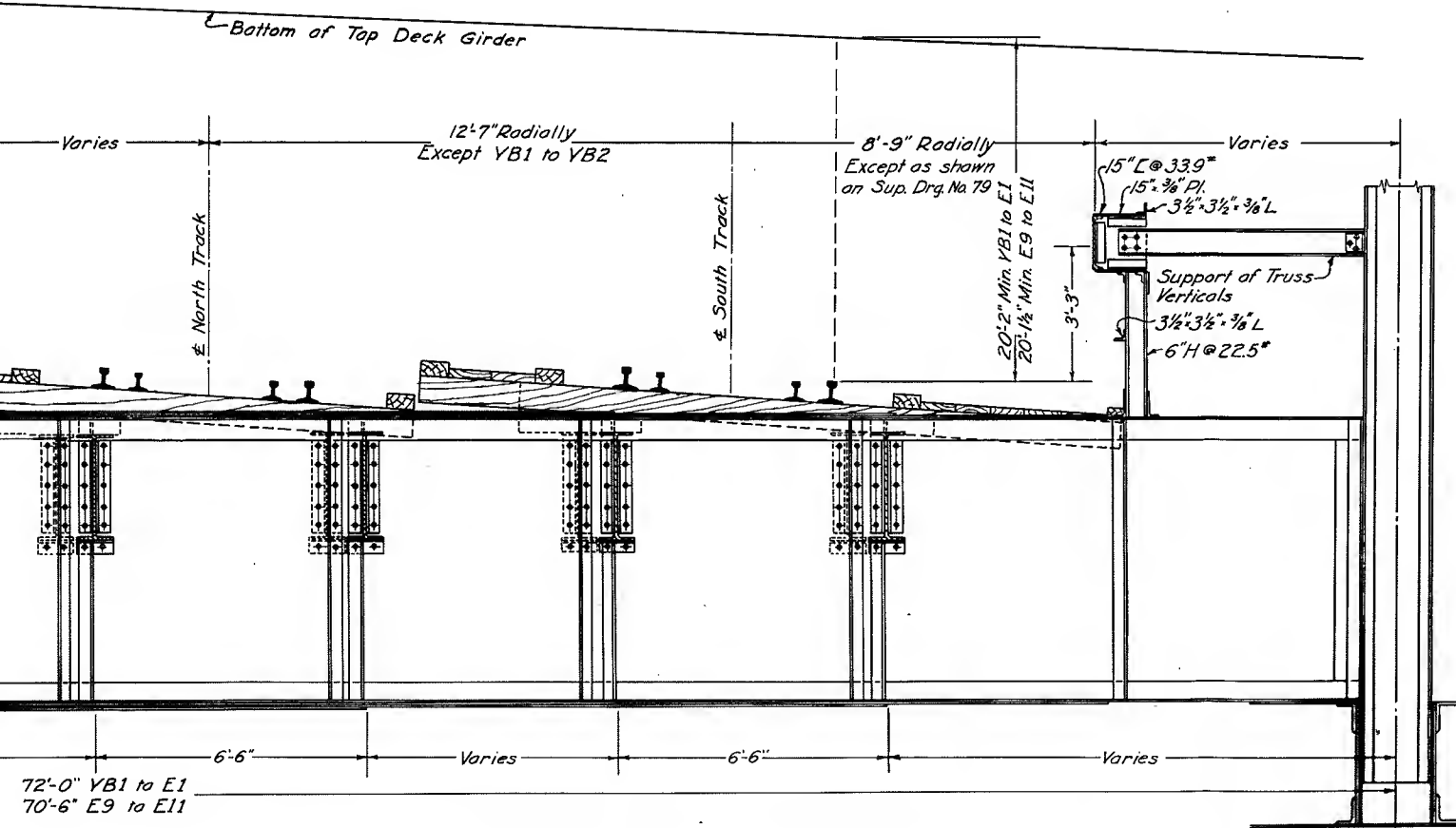
CONTRACT NO.7 SUP. DRAWING NO.76
NOVEMBER - 1933



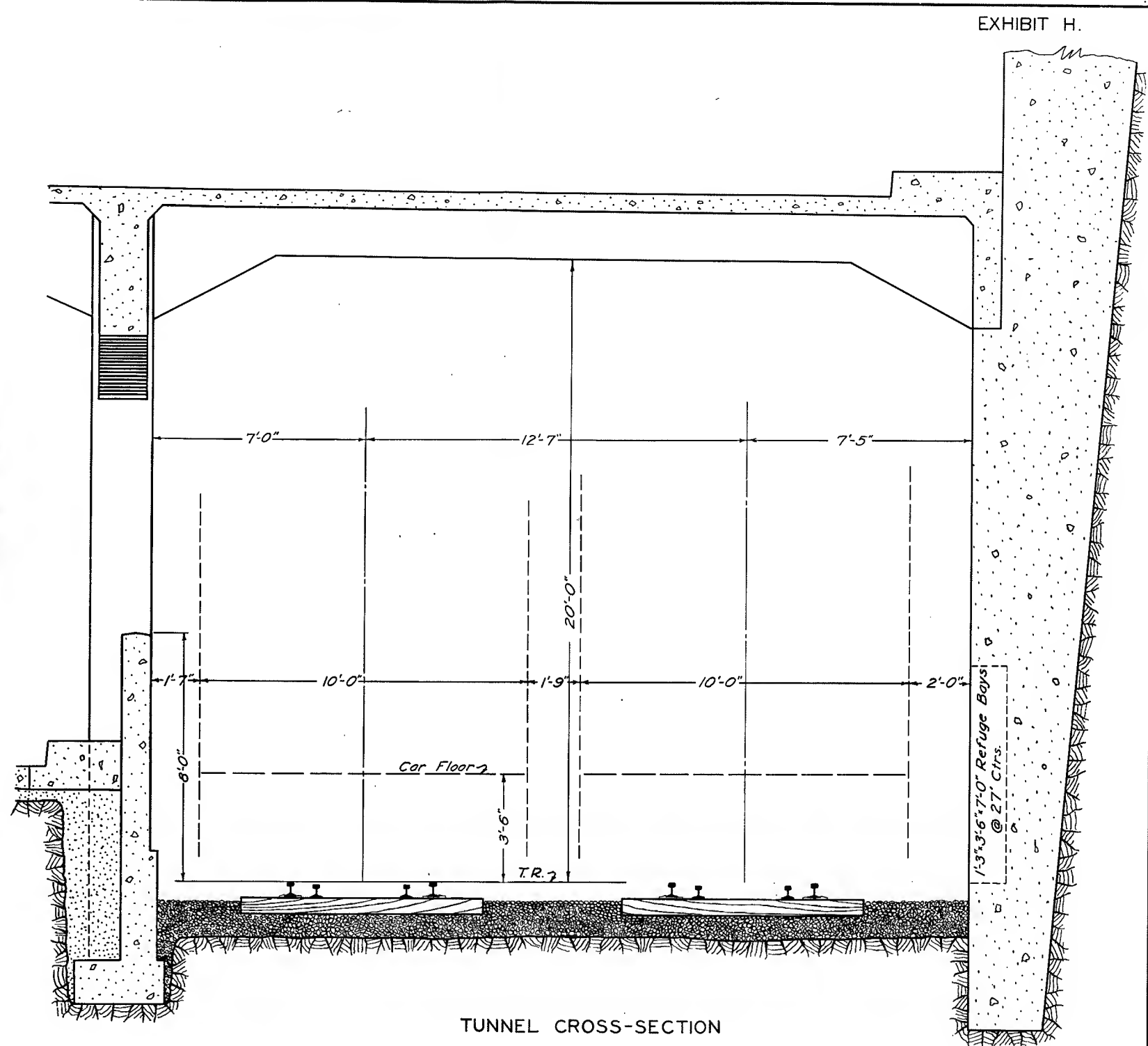
S
I
SAN FRANCISCO
SUPERSTREET
CLEARANCE
CONTRACT



BRIDGE TANGENT CROSS-SECTION



BRIDGE CURVE CROSS-SECTION

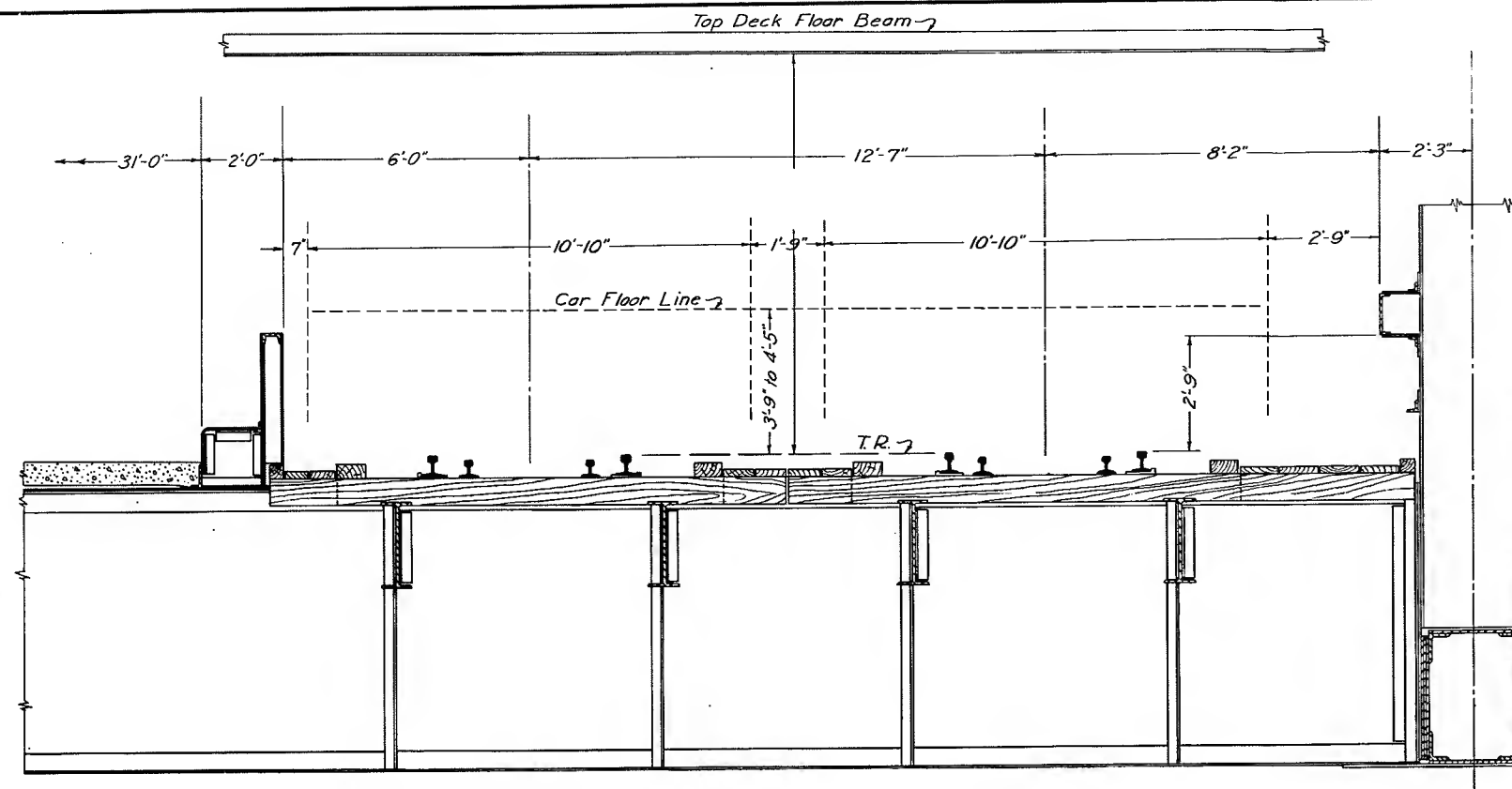


TUNNEL CROSS-SECTION

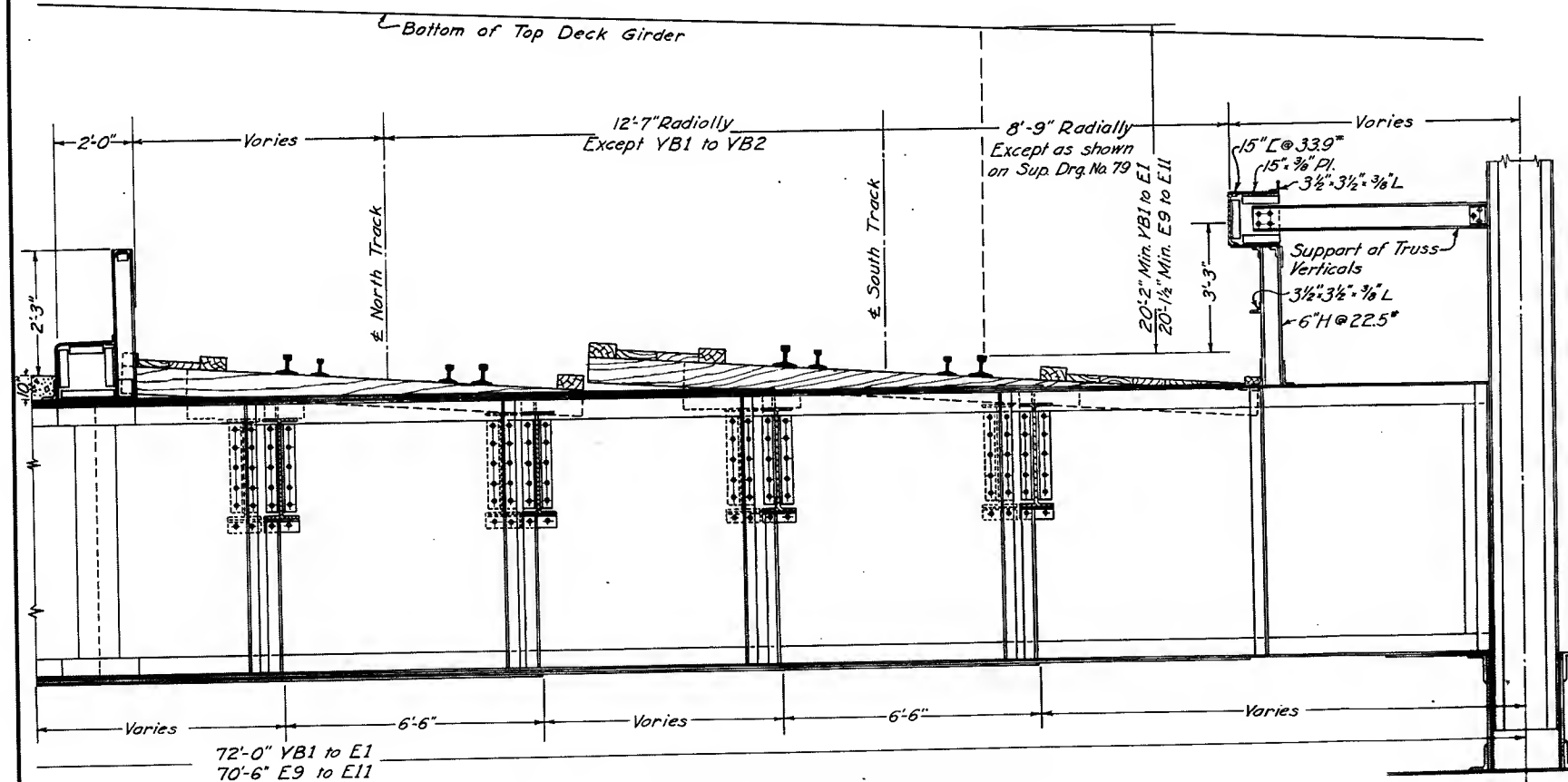
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
SAN FRANCISCO-OAKLAND BAY BRIDGE

TYPICAL INTERURBAN
RAILWAY CROSS SECTIONS

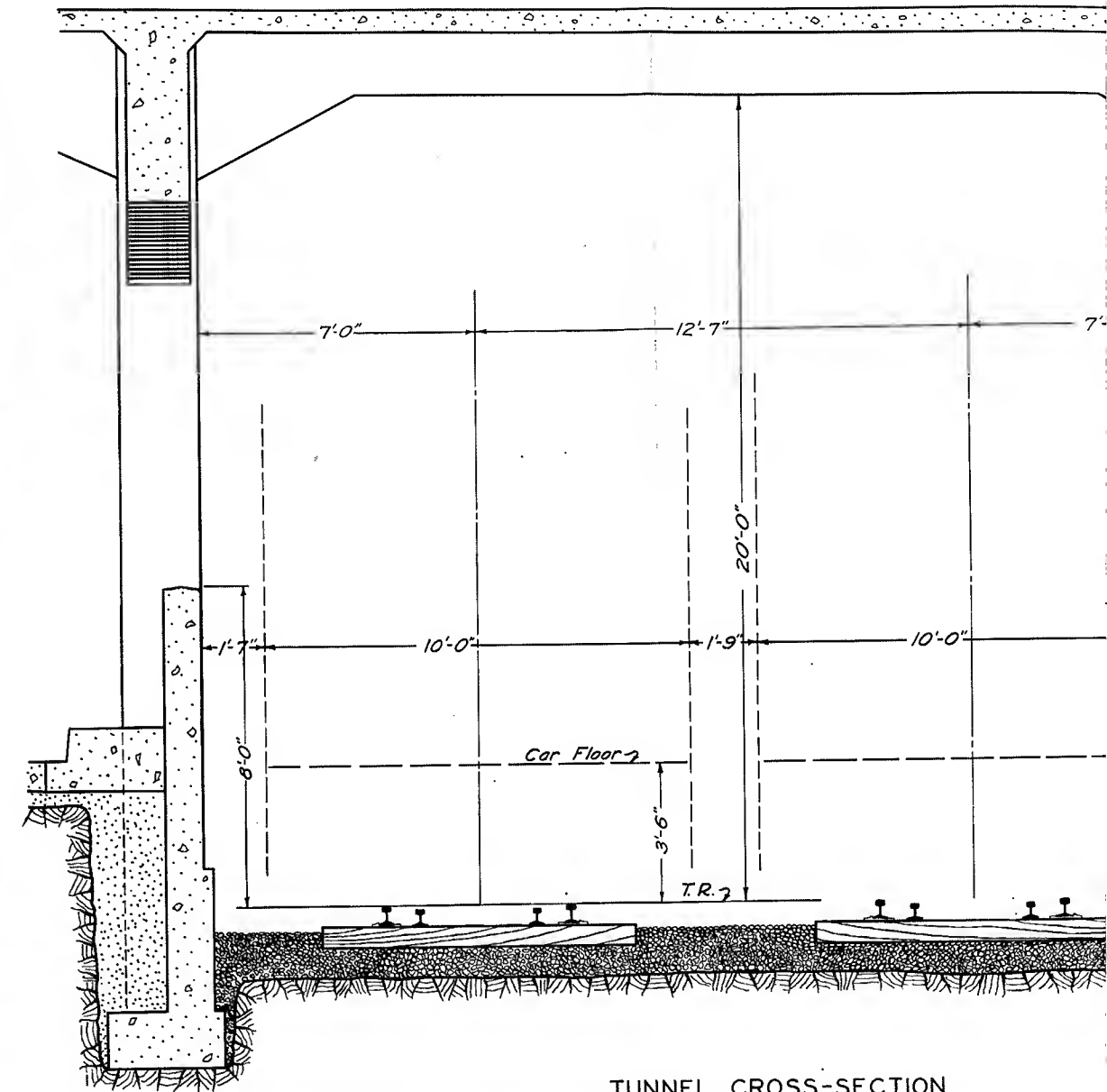
CONTRACT NO. DRAWING NO.
NOVEMBER 1933



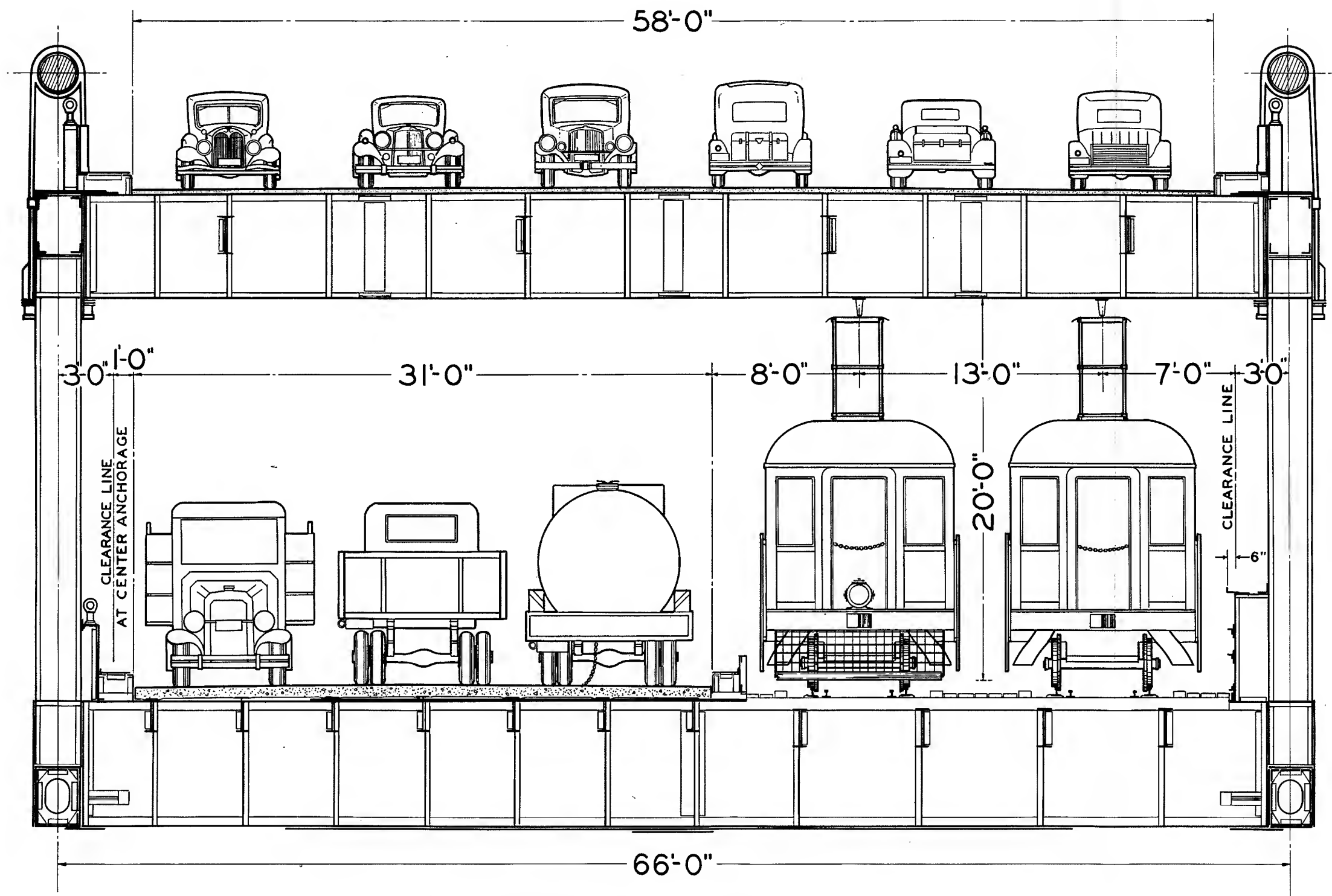
BRIDGE TANGENT CROSS-SECTION



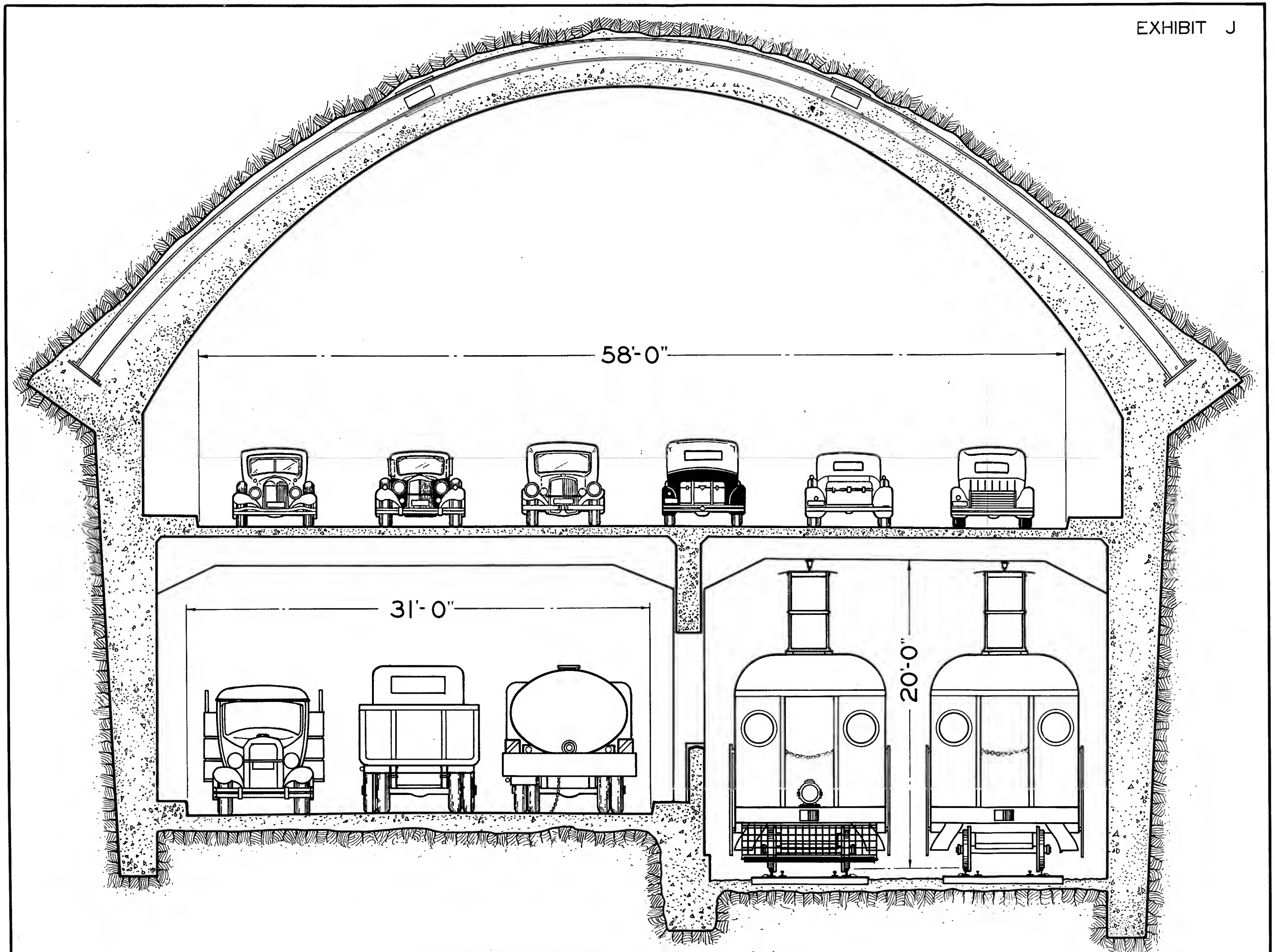
BRIDGE CURVE CROSS-SECTION



TUNNEL CROSS-SECTION



TYPICAL CROSS SECTION OF BRIDGE



CROSS SECTION THRU TUNNEL

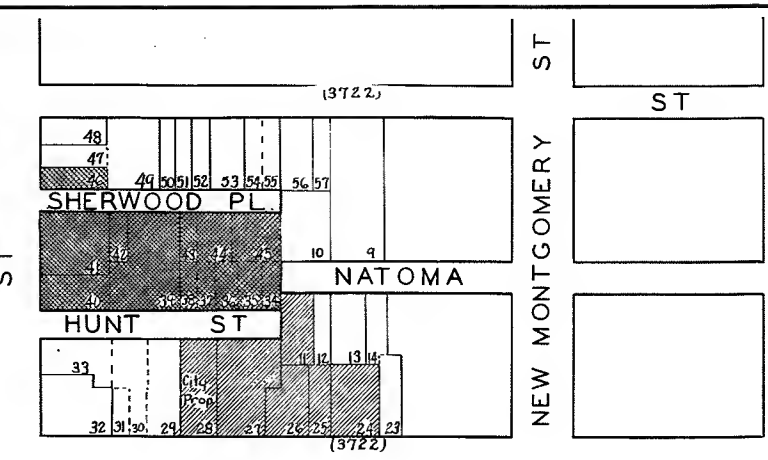
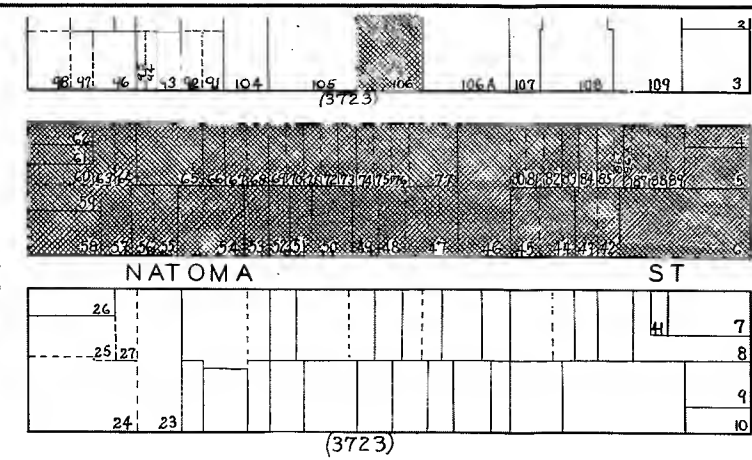
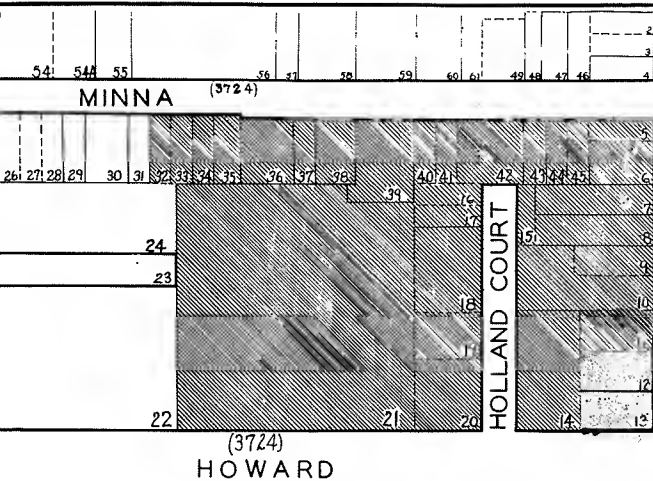


EXHIBIT K

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

SAN FRANCISCO-OAKLAND BAY BRIDGE

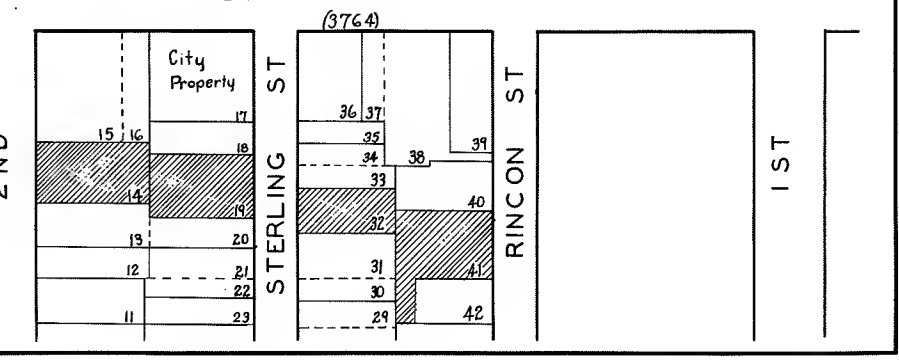
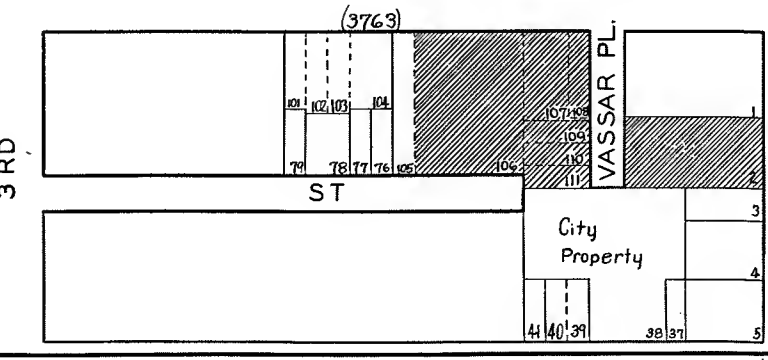
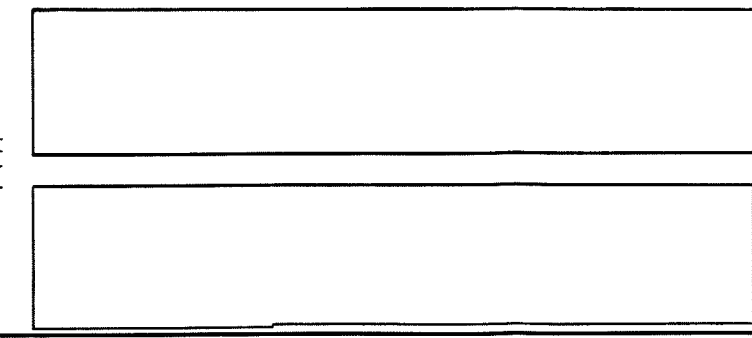
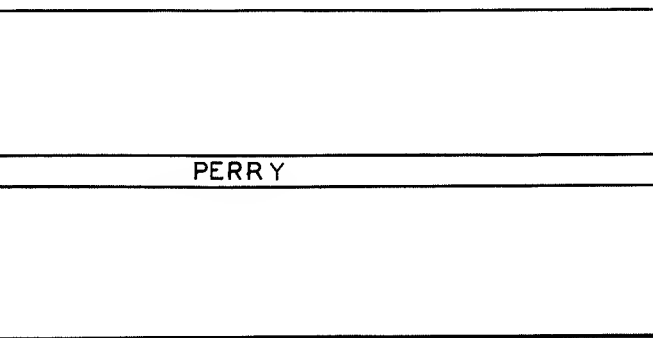
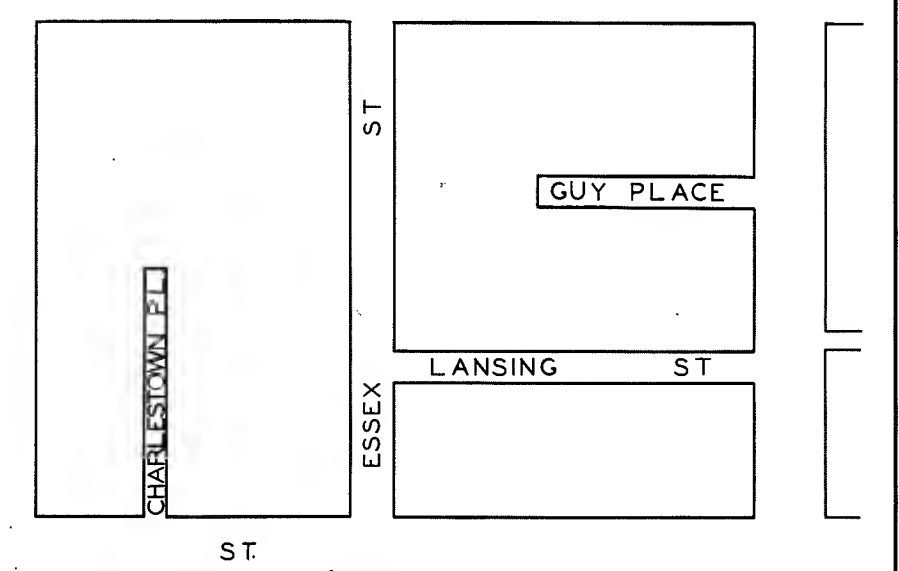
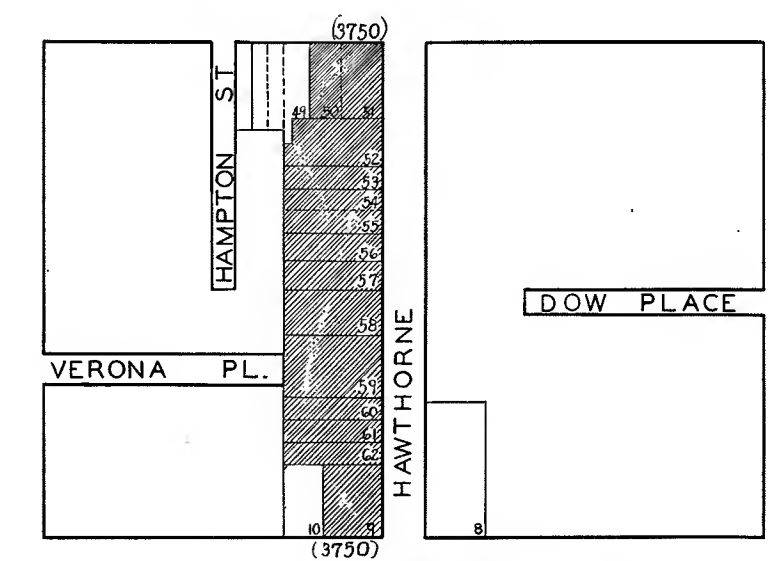
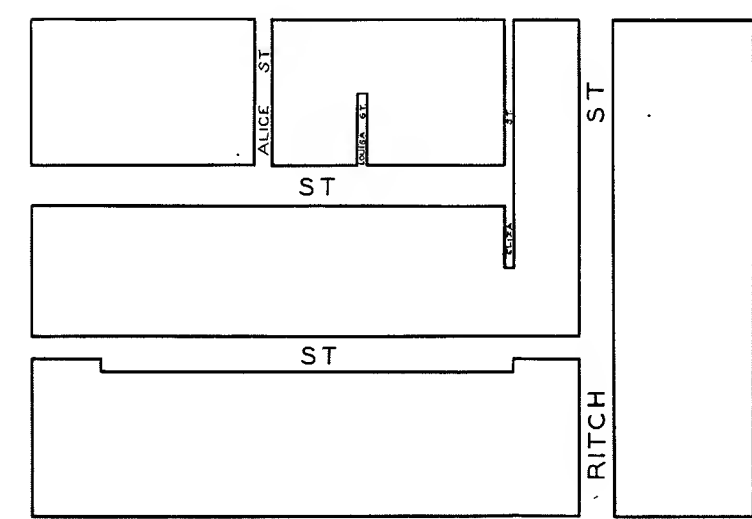
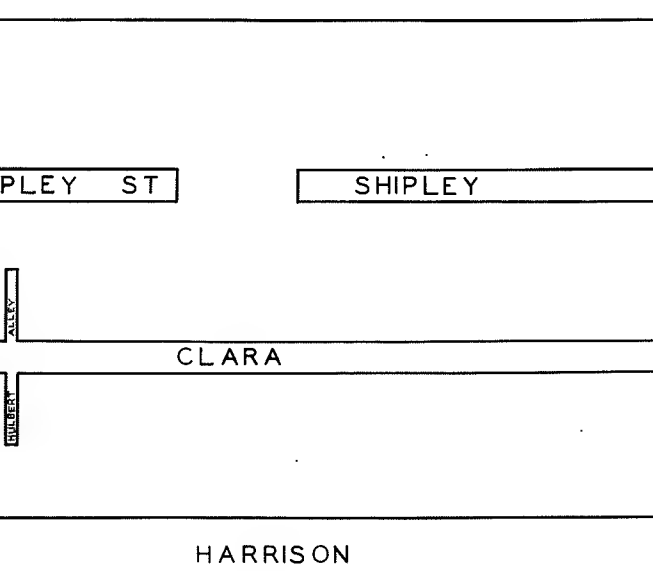
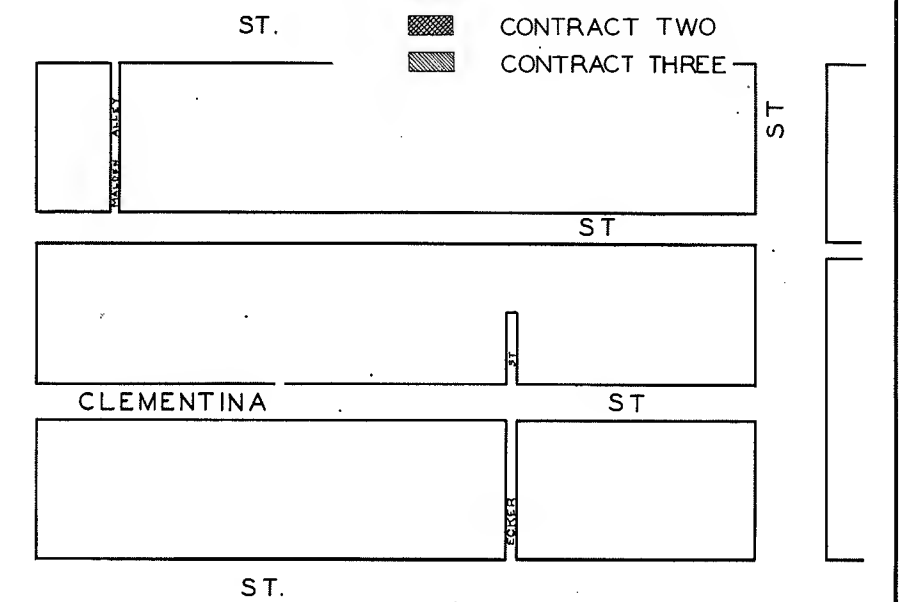
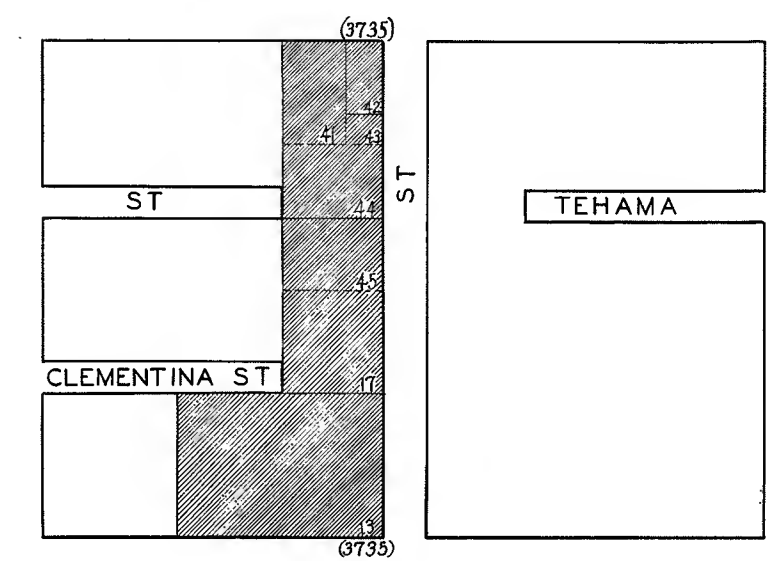
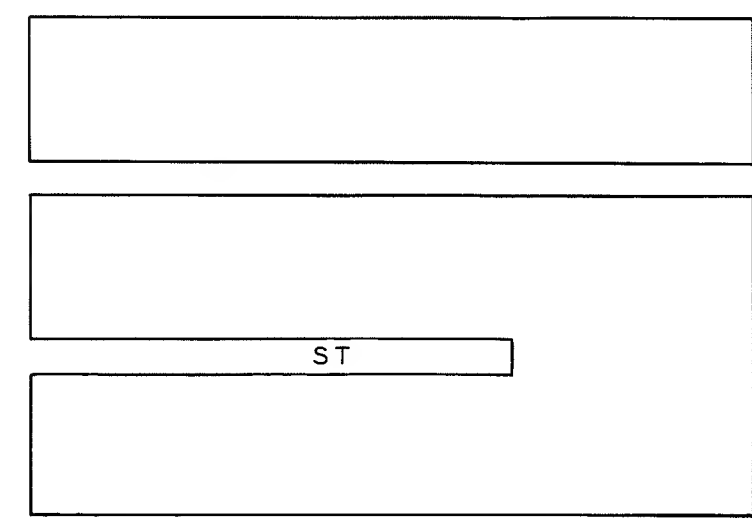
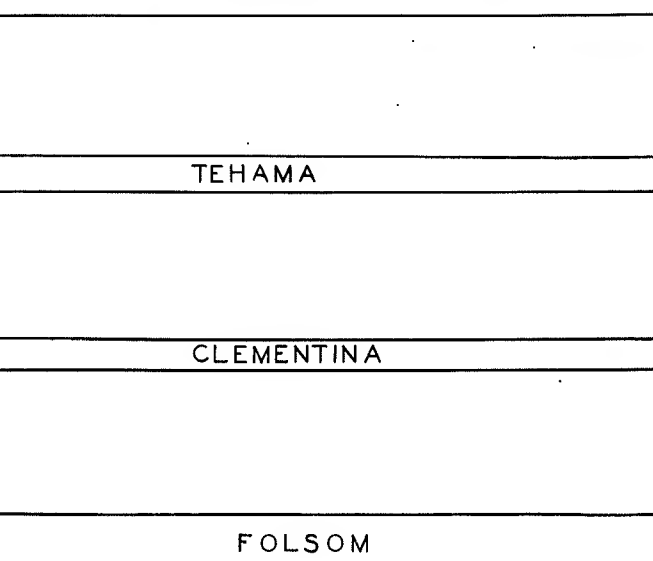
SAN FRANCISCO PROPERTY REQUIRED
FOR INTERURBAN RAILROAD

NOVEMBER - 1933

100 0 100 200

LEGEND

- CONTRACT ONE
- CONTRACT TWO
- CONTRACT THREE



100

[Legend box containing three patterns: diagonal lines, cross-hatch, and horizontal lines]

